U. S. DEPARTMENT OF AGRICULTURE.

ANNUAL REPORT

OF THE

DIVISION OF FORESTRY

FOR

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B. E. FERNOW,
CHIEF OF DIVISION.

WASHINGTON:
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REPORT OF THE CHIEF OF FORESTRY DIVISION.

SIR: I have the honor to transmit herewith my second annual report, outlining in part the work which the Forestry Division has undertaken or accomplished within the past year and the plan of work which it is desirable to pursue in future. The report also contains a brief account of the forestry conditions and forestry interests in each of the several States and Territories of the Union and, incidentally, such advice in the pursuance of practical forestry as the limited space at command would admit.

The work of the Division in the main is to act as a bureau of information.

Hitherto such information has naturally consisted in a recital of the methods of forest administration which prevail in Europe and other countries and a presentation of the needs of our country in general, based upon an imperfect knowledge of its forest conditions.

Imperfect as this knowledge is even at the present day, it is sufficient to show how wantonly our forest wealth has been and is being squandered and to demonstrate the necessity of concerted and systematic action by the Government and the people to arrest this waste in view of its threatened effects upon the future.

There is no disguising the fact that we are using up the natural wood crop at a greater rate than it replaces itself. Even the "lumberman's" papers, which had ridiculed the very idea of a possible diminution of supplies, have begun to change their tone and, with the exception of some reckless advocates of a policy of extermination, begin to realize that the interest of the great lumbering industry would be subserved by a more careful and more rational utilization of the material at hand and by greater regard to the production of a future crop.

It can not be too strongly impressed upon those who are led by the appearance of the wooded area of the country to doubt the rapid reduction of available supplies, that while absolute denudation occurs perhaps more rarely than the frequent use of the term in forestry talks would imply, devastation and deterioration in quality of the remaining or the new crop go hand in hand with the decrease of serviceable material. While the wooded area in some parts of the country is reported as increasing on account of the abandonment of worn-out farms, the quality of the new crop is inferior and the total annual production far below the total annual consumption, as I have shown in my last year's report.

At the same time the settlers on the plains and prairies of the West, for their own protection against the adversities of climate, have engaged to a considerable extent in tree-planting—hardly forest-planting—and have ascertained, at least to a limited extent, what trees of those tried may be expected to withstand a climate with a

possible annual range of temperature of over 150° F. and a possible daily range of over 50°, and in which the mean relative humidity during the months of vegetation may sink below 40 per cent. and in some parts below 30 per cent.

They have learned to some extent the proper manner of handling trees under the trying conditions of their climate, and have been successful in raising wind-breaks, shade trees, and small groves. But it would be a mistake to consider that the tree-planting of the West, though considerable in the aggregate, has reached such an extent and covered such areas that it is compensating in an appreciable degree for the disposal of the natural crop in the East, or even supplying the needs of local demand for lumber purposes, or as promising such forest conditions as will exercise an appreciable influence upon the general climate of those regions.

The observed local changes in the climatic conditions, or rather climatic effects upon crops, in the opinion of the writer, can not serve as yet as a basis upon which either to establish and defend or to controvert scientific theories regarding forest climatic influences.

That wind-breaks have done the work expected of them in breaking the force of the winds locally, in protecting locally the crops from the effects of drought and cold, will be sufficient inducement to continue their growth and maintenance. But beyond this the planting has been on too small a scale, on too confined areas, to exert that broader influence on climatic conditions which is properly claimed for extensive forest areas.

As to the increase of rain-fall, claimed as a consequence of tree-planting on the prairies, decisive statistics are not at hand; but it may be stated, with sufficient scientific basis to rest upon, that the breaking up of the soil over large areas for agricultural purposes has contributed to the retention of whatever moisture of the atmosphere is precipitated in the regions in question, and this retention has also tended, no doubt, to cause more frequent precipitation and the formation of dew, without necessarily increasing the amount of the total annual or even monthly rain-fall.

NOTE 1.—There has been of late much discussion as to whether or not there exists any relation between forest cover and rain-fall, and records of meteorological data have been brought forward to show that in Ohio, for instance, deforestation, if anything, has had the effect of increasing rain-fall, while no increase of rain-fall has been noticeable in Kansas since tree-planting there. How little value can be attached to the use of the records on hand for showing any inter-relation between tree-growth and rain-fall may be inferred at once from the fact that these same records can be and have been used to prove exactly the opposite influences, showing, without reference to the causes, that an increased precipitation in the Western regions is observable. In fact, outside of the special observations which have been made in Germany, and less satisfactorily in France, there are no data at hand for definitely proving either the existence or the absence of forest influences on the humidity of the atmosphere. This influence, as probably most forest influences, is of local character, *i. e.*, the extent to which the influence is felt is limited and can be measured only by special records for each locality. It is not unreasonable to believe that the influence of a forest area upon rain-fall may be exactly the opposite from beneficial to the plain beyond, and yet this does not alter the proposition that an influence exists. If, for instance, a large, uninterrupted forest area were lying towards the side of the rain-bringing winds it is possible that the condensation to which the cooler and relatively moister air above the forest would give rise might drain the clouds before they had passed on to the plain, and thus a partial removal of the forest growth might be promotive of moisture on the plain. The reasoning that a large, dense forest cover of the soil, sufficiently large and dense to create a considerable difference of temperature and with it of moisture in its air strata, should exert an influence upon precipitation seems to be sound; but while the actual ex-

istence of such influence seems to have been locally observed it is not as a general proposition proved or disproved.

That the transplanting in Kansas should have been sufficient to create such differences of atmospheric conditions as are necessary to exert an influence upon rain clouds is at least doubtful, and the reasons above given for the increase of rain-fall, if any, seem more tenable.

Meanwhile the well-proved mechanical influences of forest growth on the even distribution of the fallen rain through the year in springs, brooks, and rivers outweighs all other considerations for practical purposes.

NOTE 2.—*Reported number of planted forests in* 1887 *of* 5 *or more acres in extent.*

Through the agency of the Statistical Division an attempt was made to arrive at an estimate of the actual forest-planting throughout the country by calling upon the statistical agents for the addresses of all persons who had planted areas of 5 acres or more to forest trees. The result of this inquiry, although of great advantage to the work of this division in securing the addresses of many tree-planters, has not made it possible to obtain an answer to the main question, partly probably because the object of the inquiry was not understood. For the sake of inviting co-operation in correcting the reports thus secured the results have been here tabulated. No reports have been received from the States and Territories not found in the list below. As stated, the reports here given are quite unreliable as an indication of the total amount of forest planting in the country or even in the States reporting. On the other hand, many reports of tree-planting in the prairie and other States which are published from time to time are misleading exaggerations. They may be correct as to the number of trees planted, but they include such as have been planted by the roadside and around dwellings for ornament and those planted for screens and shelter belts, as well as those planted in masses for forest purposes. But scattered trees, however numerous, do not make a forest and are of no account in forestry estimates. It is unfair, therefore, to take, as has been done, the whole number of trees planted and dividing it by the number required by the timber-culture act to be planted on each acre to consider the result as properly indicating the present acreage of artificial forests. Nor can we accurately estimate even the forest acreage of trees planted under the timber-culture act until the claims under that act are proved up.

States.	No.	States.	No.	States.	No.
Vermont:		Minnesota—Continued.		Dakota Ter.—Continued.	
Windsor County	4	Big Stone County	1	Yankton County	8
Massachusetts	[1]	Grant County	7	Campbell County	100
Virginia:		Nicollet County	2	Cavalier County	[4]11
Montgomery County	1	Blue Earth County	2	Dickey County	12
Indiana:		Pope County	3	Morton County	[5]12
Spencer County	1	Yellow Medicine Co	8	Pennington County	3
Sullivan County	2	Watonwan County	7	Sully County	60
Illinois:		Rock County	12	Hughes County	10
Douglas County	1	McLeod County	1	Mercer County	[6]11
Edgar County	1	Sibley County	11	Jerauld County	12
Menard County	1	Redwood County	16	Clark County	12
Ogle County	6	Hennepin County	1	Brulé County	7
Shelby County	1	Faribault County	[3]	Walsh County	5
Vermilion County	2	Dakota Territory:		Pembina County	1
Kankakee County	1	Hamlin County	12	Cass County	[7]13
Minnesota:		Barnes County	23	Charles Mix County	8
Norman County	12	Grant County	8	Sanborn County	[8]4
Nobles County	10	Burleigh County	12	McIntosh County	5
Lac-qui-parle County	100	Fall River County	11	Hutchinson County	12
Chippewa County	4	Stutsman County	4	Bon Homme County	500
Kandiyohi County	3	Faulk County	6	Lincoln County	13
Renville County	14	Eddy County	4	Coddington County	7
Brown County	[2]15	Turner County	19	Walworth County	[9]
Swift County	2	Spink County	14	Day County	[10]300
Fillmore County	+2	Hand County	1	Lawrence County	100
Traverse County	8	Buffalo County	9	Moody County	[11]500

[1] 5,913 acres. Official State statistics. Returns by counties not received.
[2] Several exceeding 5 acres.
[3] No exact report, but hundreds of farms said to have over 5 acres.
[4] Several of these have 10 acres.
[5] Many not reported are known to have plantations of 5 acres.
[6] Some plantations of 10 acres.
[7] Reported as 10 acres each.
[8] Many plantations of cottonwood in addition.
[9] Many plantations of 5 acres or more, but number not reported.
[10] One-half reported as in good condition.
[11] Nearly every section said to have a plantation of 5 acres or more.

States.	No.	States.	No.	States.	No.
Nebraska:		Kansas—Continued.		Iowa—Continued.	
Frontier County	4	Sumner County	2	Tama County	5
Saunders County	1	Wabaunsee County	1	Sioux County	29
Lancaster County	4	Butler County	2	Lyon County	1
Furnas County	[12]12	Lane County	3	Osceola County	1
Sheridan County	19	Mitchell County	7	Guthrie County	2
Saline County	6	Norton County	8	Palo Alto County	19
Kearney County	5	Rooks County	20	Hamilton County	2
Dixon County	9	Russell County	8	Adams County	6
Washington County	5	Ford County	2	Union County	11
Douglas County	6	Gray County	1	Shelby County	2
Johnson County	13	Riley County	3	Cedar County	1
Hitchcock County	15	Decatur County	6	Missouri:	
Wheeler County	2	Phillips County	4	Holt County	8
York County	6	Labette County	2	Caldwell County	2
Nemaha County	24	Nebraska County	3	Adair County	2
Thayer County	5	Stafford County	163	Washington Territory:	
Loup County	36	Comanche County	1	Lincoln County	[20]12
Cass County	7	Chase County	2	Klikitat County	8
Hamilton County	2	Sheridan County	2	Yakima County	5
Webster County	10	Lincoln County	13	Oregon:	
Platte County	24	Graham County	1	Morrow County	6
Cherry County	12	Ellsworth County	[16]1	Malheur County	1
Burt County	9	Gove County	1	Crook County	2
Kansas:		McPherson County	[17]7	Lake County	5
Douglas County	2	Iowa:		Colorado:	
Ness County	21	Monona County	9	Larimer County	2
Cheyenne County	3	Mills County	8	Weld County	5
Pawnee County	4	Calhoun County	4	Burt County	16
Barton County	26	Fayette County	2	El Paso County	5
Reno County	22	Greene County	5	Idaho Territory:	
Rice County	[13]+17	Pocahontas County	11	Bingham County	4
Cloud County	1	Carroll County	3	Washington County	1
Clay County	10	Sac County	22	Utah Territory:	
Dickinson County	[14]13	Davis County	1	Beaver County	1
Harvey County	4	Cherokee County	4	San Pete County	2
Pratt County	1	Lucas County	1	California:	
Ottawa County	5	O'Brien County	[18]500	San Bernardino County	1
Davis County	[15]2	Johnson County	6	Marin County	3
Cherokee County	5	Clay County	[19]6	Mendocino County	1
Atchison County	5	Audubon County	14	Arizona Territory:	
Sedgwick County	5	Jackson County	1	Arizona County	1
Woodson County	1	Clinton County	2	New Mexico Territory	29
Norton County	2	Butler County	2		
Rush County	8	Grundy County	10	No. plantations reported	3,605
Ellis County	18	Woodbury County	7		

[12] There are many others, but not reported.
[13] One plantation of 25 acres.
[14] Hundreds more.
[15] One plantation of 40 acres.
[16] Large numbers not reported.
[17] Two plantations of 40 acres and 1 of 20 acres.
[18] Nearly every farmer has 5 or more acres of planted trees.
[19] Some groves of 20 acres.
[20] Correspondent says "hundreds."

It must not be overlooked that the forestry problem is an essentially different one for every section of our country.

In New England and the Northeastern States it involves probably the solution of the questions, what can we do to make the natural forest areas more quickly and more fully productive in future? how can we best make our waste places valuable by forest growth? and how can we best protect forest property? In the South it may be the question, how can we utilize our timber to best advantage without impairing the continuity of the forest as a valuable property? On the prairies, what can we do to secure in the quickest and most permanent manner such forest growth as will bring climatic comforts? On the Rocky Mountains and other mountain districts, how should we manage the natural forests so as to secure their renewal and the benefits on water flow which their continuity alone assures? While on the Pacific Slope all the considerations contained in these questions have place.

It is gratifying to note that the interest in the forestry problem is growing in every section; that the discussions have become of a more precise and practical character, and that sentimental enthusiasm for reform is supplemented by rational considerations and propositions.

The States of Kansas and California have started upon practical work in aid of active forestry; the State of Colorado is gradually moving in the same way; the States of Michigan and Pennsylvania have awakened to the conception that their forestry interests deserve attention, and in other States, as will appear from the accounts given further on, the interest in forestry matters has considerably increased within the last two years, and as a result in some of the States action has been taken by the legislatures for the protection of their forests. To keep such interest alive and growing, a considerable amount of missionary work has been done by this division the past year, and has entailed upon the writer the preparation of not less than ten addresses, on as many different aspects of the forestry question, given before forestry and horticultural associations, State boards of agriculture, and other societies, lectures delivered in various places, the writing of many letters of advice on general and special questions, and of circulars of information. Of these latter, the following, deserving perhaps further circulation than has hitherto been given it, is here reproduced in full, serving at the same time as a sample of the information which is furnished by this Division:

CIRCULAR OF INFORMATION TO WOOD CONSUMERS.

Increasing the durability of timber.

Our people waste a large amount of timber and of labor by lack of care for the timber after it is cut. Rotting timbers and fence posts necessitate not only the cutting of a large quantity of wood, but also the labor of replacing the same oftener than if the wood could be made to last longer.

There are some rules in the handling of timber which are too often overlooked, and which should be observed by everybody who uses wood in places where it can not be kept dry or wholly submerged.

There is also much unintelligent use of paints and other coatings, applied in the hope of preserving timber, when it should be well known that by painting green or badly-seasoned timber decay is hastened rather than prevented.

While to many it may be impossible to apply the more complicated and expensive methods of wood preservation which recommend themselves to large consumers of wood material, knowledge of the following considerations will aid the small consumer to handle his material to better advantage, to utilize forest products more thoroughly and intelligently, and to make them last from two to three times as long as when not observed.

(1) *Decay of wood* is due to fermentation of the sap, induced probably by the growth of either bacteria or fungi. These organisms need for their development warmth and moisture besides the nitrogenous substances and salts contained in solution in sap.

To prevent the growth of these ferments, therefore, the sap in the wood must be dissolved, leeched out, or dried out, and moisture be prevented from re-entering.

(2) *The manner of use influences durability of timber.*—Timber entirely submerged under water or in deep soil (drain pipes) will practically not decay, nor is it liable to rot when kept absolutely dry, away from the influence of humid atmosphere. Wood decays in proportion to the warmth of the temperature.

On northern exposures, in cool valleys, on high elevations in northern countries, the duration of wood is longer than when placed under opposite influences.

If wood is used in the ground, decay proceeds the more rapidly (beginning with the point of contact with the soil) the looser, moister, and warmer the soil, and especially the greater liability of change from dry to wet; therefore timber will last longer in heavy, always moist, clay, than in loose, alternately moist and dry gravel, or in warm, comparatively dry lime soils.

Rooms without ventilation induce decay, producing the dry-rot (which first appears in white patches, changing into brown or gray). Ventilation, drying out, and insulation from moisture will cure this defect.

(3) *Natural factors influencing durability.*—Sound mature trees yield more durable timber than either young or very old trees. Maturity is the time when trees have ceased to grow vigorously, which is indicated by a flattening of the crown, dying out of branches in the crown, and by the change of color of the bark. Maturity may be reached according to circumstances by the same species, when the diameter is only a few inches or when it is as many feet. The small tree on arid soil, or overtopped by others from its birth, may be as old and older than a tree of greater dimensions growing under more favorable conditions. Of two pieces of the same kind the heavier is the more durable, although absolute weight of two different kinds of timber does not determine their relative durability.

Heart-wood, as a rule, can resist deterioration longer than sap-wood, because it contains less sap; but when the sap-wood is well seasoned and heavier, this difference disappears.

The site has an influence on durability in so far as it influences the formation of heavy wood.

Quickly-grown hard woods with wide annual rings, and *slowly-grown conifers* with narrow (yet not too narrow) rings, and "tapped" pines (on the tapped side) yield, as a rule, the most durable wood, other conditions being alike.

Conifer wood from poor soils, high altitude, and dense forest, hard woods from rich, deep, warm soils and isolated position, are most durable.

The resinous substances in conifers form an element of protection against decay.

(4) The following list of trees comprises most of those of common occurrence which have been found to be the most durable. Without means of determining the exact relative value of the different species it has been possible to give only a series which, in general, proceeds from the most durable to less durable ones:

EASTERN RANGE.—Conifers: Red Cedar (*Juniperus Virginiana*, L.); White Cedar (*Chamæcyparis sphæroidea*, Spach.); Arbor-Vitæ (*Thuya occidentalis*, L.); Bald Cypress (*Taxodium distichum*, Rich.); Long-leaved Pine (*Pinus palustris*, Miller); Red Pine, (*Pinus resinosa*, Ait.); Cuban Pine (*Pinus Cubensis*, Griseb.); Short-leaved Pine, (*Pinus mitis*, Michx.) Broad-leaved trees: White Oak (*Quercus alba*, L.); Post Oak (*Quercus obtusiloba*, Michx.); Basket Oak (*Quercus Michauxii*, Nutt.); Burr Oak (*Quercus macrocarpa*, Michx.); Chestnut Oak (*Quercus prinus*, L.); Live Oak (*Quercus virens*, Ait.); Osage Orange (*Maclura aurantiaca*, Nutt.); Hardy Catalpa (*Catalpa speciosa* Warder); Black Locust (*Robinia pseudacacia*, L.); Red Mulberry (*Morus rubra*, L.); Chestnut (*Castanea vulgaris*, var. *Americana*, A. D. C.).

ROCKY MOUNTAIN REGION.—Red Cedar (*Juniperus Virginiana*, L.); Piñon Pine (*Pinus edulis*, Engelm.); Fox-tail Pine (*Pinus Balfouriana*, Murray); Douglas Spruce (*Pseudotsuga Douglasii*, Carr); Western Larch (*Larix occidentalis*, Nutt.); Burr Oak (*Quercus macrocarpa*, Michx.).

PACIFIC SLOPE.—Yew (*Taxus brevifolia*, Nutt.); Redwood (*Sequoia sempervirens*, Endlicher); Lawson's Cypress (*Chamæcyparis Lawsoniana*, Parl.); Canoe Cedar (*Thuya gigantea*, Nutt.); Douglas Spruce (*Pseudotsuga Douglasii*, Carr.); Western Larch (*Larix occidentalis*, Nutt.); Live Oak (*Quercus chrysolepis*, Liebm.); Post Oak (*Quercus Garryana*, Dougl.).

(5) *Time of felling.*—With proper after-treatment of the wood the time of felling seems not to affect its durability. Early winter felling (December) should have the preference, because less fermentable sap is then in the trees, and the timber will season with less care, more slowly and more evenly, and before the temperature is warm enough for fermentation to set in.

If the wood is cut "in the sap" it is more liable to fermentation and to the attacks of insects, and more care is necessary in seasoning; for the rapid seasoning, due to the warm, dry atmosphere, produces an outer seasoned coat which envelopes an unseasoned interior liable to decay. When cut in the leaf it is advantageous to let the trees lie full length until the leaves are thoroughly withered (two or three weeks) before cutting to size. With conifers this is good practice at any season, and if it can be done, all winter-felled trees should be left lying to leaf out in spring, by which most of the sap is worked out and evaporated.

(6) *Treatment after felling.*—Always remove the bark from felled timber to aid seasoning, but not from the standing tree.

Never allow the log to lie directly on the moist soil.

If winter-felled, shape the timber to size within two weeks after felling, and leave it placed on blocks—not upon the soil—in the forest, or if shaped at home place in a dry, airy—not windy—position away from sun and rain.

If dried too rapidly, wood warps and splits, the cracks collect water, and the timber is then easily attacked and destroyed by rot.

With large logs, checking may be prevented by coating the ends with some fatty or oily substance mixed with brick dust, or with a piece of linen cloth, or even

paper, or by simply shading them to lessen evaporation; cracks on the sides may be filled in with tow or cotton.

When piling timber, place laths or sticks of uniform size at uniform distances under each log, or post, or tie.

Sufficiently thorough seasoning for most purposes is obtained in twelve to eighteen months, while for special work, according to the size, from two to ten years are required.

The best method of obtaining proper seasoning without costly apparatus in shorter time, is to immerse the prepared timber in water from one to three weeks, to dissolve the fermentable matter nearest the surface. This is best done in running water. If such is not at hand, a bath may be substituted, the water of which needs frequent change. Timber so treated, like raft timber, will season more quickly and is known to be more durable.

If practicable, the application of boiling water or steam is an advantage in leeching out the sap.

(7) *Coatings to keep out moisture.*—Never apply paint or any other coating to green or unseasoned timber.

If the wood was not well dried or seasoned the coat will only hasten decay.

Good coatings consist of oily or resinous substances which make a smooth coat, capable of being uniformly applied. They must cover every part; must not crack, and possess a certain amount of plasticity after drying.

Coal tar, with or without sand or plaster or pitch, especially if mixed with oil of turpentine and applied hot (thus penetrating more deeply), answers best. A mixture of three parts coal tar and one part clean, unsalted grease, to prevent the tar from drying until it has had time to fill the minute pores, is recommended. One barrel of coal tar ($3 to $4 per barrel) will cover three hundred posts. Wood tar is not serviceable because it does not dry.

Oil paints are next in value. Boiled linseed oil or any other drying vegetable—not animal—oils are used with lead or any other body (like pulverized charcoal) to give substance. Immersion in crude petroleum is also recommended.

Charring of those parts which come into contact with the ground can be considered only as an imperfect preservative, and unless it is carefully done, and a considerable layer of charcoal is formed, the effect is often detrimental, as the process both weakens the timber and produces cracks, thus exposing the interior to ferments.

Lastly, in communities where durable timber is scarce it will pay to establish a plant for impregnating timber with antiseptics by the more costly processes described in Forestry Bulletin No. 1.

Bulletin No. 1 of the Forestry Division, being a report on the relation of railroads to forest supplies and forestry, issued after much delay, has found a most appreciative reception among railroad men and civil engineers, showing that the information contained in the several papers on technical subjects was timely and desirable.

The first issue of 2,500 copies not satisfying the demand, a second edition of 2,500 was ordered.

To keep the railroad companies, whose interests in forestry were shown in the report to be of stupendous magnitude, in sympathy with the work of the Division, it is contemplated to issue from time to time such information of practical value as may aid in forest preservation and reforestation on the part of these most important consumers of forest products. In pursuance of this plan the following circular, resulting from a visit of the writer to northern Alabama, was sent to the offices of railroad managers and master car builders:

FOR INFORMATION OF RAILROAD MANAGERS.

GENTLEMEN: Hoping that you have appreciated the manner in which the Forestry Division of this Department has, by its first bulletin, attempted to call the attention of railroad managers to the need of economy in the use of forest supplies, allow me, in furtherance of such economy, to present the following statements, which may be of interest to you.

In the use of oak for cross-ties, the specifications of most roads, especially those of the South, call for White Oak (*Quercus alba*), a timber which is sought for also by almost every industry employing oak, and which is therefore rapidly decreasing

and approaching comparative exhaustion. Meanwhile, millions of feet of Tanbark or Chestnut Oak (*Quercus prinus*) are rotting in the forests, after being stripped of their bark, because their value for cross-ties is not known or is underestimated in many regions.

This lack of appreciation of the value of this wood causes not only waste of the wood itself, but waste of the bark also, as without ready demand for the wood it does not pay to peel the larger limbs.

From information furnished by Dr. Mohr, of Mobile, Ala., an expert in forestry statistics and agent of this Department, it appears that from the line of the Louisville and Nashville Railroad, south of the Tennessee River, between 5,000 and 7,000 cords of bark are shipped annually, involving the felling in that district alone of from 10,000 to 13,000 trees which are consigned to useless destruction, while capable of yielding not less than 100,000 first-class railroad ties.

As to the lasting quality of the timber of Chestnut Oak experiences are reported from Cullman, Ala., to the effect that posts of this oak outlast those made of White Oak, partly probably because the timber is peeled. One reliable report states that Tanbark Oak posts were found to be sound after twelve years, while those of White Oak in the same construction had to be replaced several years sooner. Reports from railroad companies, where this wood is used for ties, give their life as from five to ten years, while the reports for White Oak give from three to twelve years. In the average, all the oaks which are known as "white oaks," named below, last between seven and eight years in the road-bed.

That the oaks of this class may be used for railroad construction interchangeably, and do not offer any appreciable differences in the qualities most essential for a good railroad tie, the following table, compiled from the census report, may serve to show. The column of specific gravity will allow an estimate in regard to adhesion of spikes, while the column of indentation allows an estimate as to resistance to cutting of rail. The position as to quality, in comparison with the other kinds mentioned, is indicated by numbers in parenthesis:

	Range.	Weight per cubic foot.	Specific gravity.	Resistance to indentation.	Elasticity.	Transverse strength.
White Oak (*Quercus alba*, L.).	East of the Rocky Mountains.	46.35	.747 (4)	3288 (6)	97089 (2)	905 (4)
Chestnut or Rock-chestnut Oak (*Quercus prinus*, L.).	Northeastern and in Kentucky, Tennessee, and Alabama.	46.73	.7499 (3)	3688 (5)	125473 (1)	1031 (2)
Basket or Cow Oak (*Quercus Michauxii*, Nutt.).	Southeastern.....	50.1	.8039 (2)	3725 (4)	96373 (3)	1118 (1)
Burr, Mossy-cup, or Overcup Oak (*Quercus Macrocarpa*, Michx.).	Northern United States.	46.45	.7453 (6)	3730 (3)	92929 (4)	982 (3)
Post or Iron Oak (*Quercus obtusiloba*, Michx.).	East of Rocky Mountains.	52.14	.8367 (1)	4415 (1)	83257 (5)	872 (6)
California White Oak (*Quercus Garryana*, Dougl.).	Pacific coast.....	46.45	.7453 (5)	3846 (2)	81109 (6)	879 (5)

From these figures it would seem that, contrary to the accepted notion, the White Oak, par excellence, is inferior in all particulars to the Chestnut Oak, and in general not superior to any of the others.

Trusting that the above information will be of value to you, and that so far as your conditions enable you to make use of it you will do so, and thus to some extent aid in economizing timber supplies.

Yours, respectfully,

NORMAN J. COLMAN,
Commissioner of Agriculture.

NOTE.—It must not be overlooked that, as the Chestnut Oak, when cut for bark, is felled "in the sap," the after-treatment is of greatest influence upon the durability of its timber, for which see circular on page 5.

The annual report of the Chief of the Division for 1886 appeared in separate print of 1,300 copies, but the demand for extra copies has far exceeded the supply. It is to be regretted that for an interest which, like that of forestry, requires a constant leaven to work in arousing and educating popular sentiment the means of reaching

the people are not more adequate. Feeling that the method of imparting information is often as important as the information itself, the writer proposed to the National Grange to undertake the popularization of such information which does not easily reach the non-reading farmer, and as a consequence the following four leaflets were written and published by the Grange, to be followed by similar leaflets in other branches of agricultural knowledge:

(1) *What is forestry?* It is the same thing as agriculture—a business. The difference is only in the kind of crop and in the manner of treating the crop. It is the production of a wood crop we are after. This is the crop which grows, or can be made to grow, on those parts of the farm which are useless for all other crops. It is a slow-growing crop, to be sure, but it grows while you are asleep, and you need put it into the ground but once, where it will thrive without further care for many years; and if properly started it needs no hoeing, no cultivating, no worrying about the weather. And when you come to reap it, it will prove to yield a profit from ground that would otherwise have been left not only unproductive but unsightly in addition.

If only for the looks of it, a piece of young timber thriftily growing enhances the value of the farm. Therefore plant the unsightly waste places to trees; remove those ugly spots from your farm which spoil its good looks. It costs but little more than an occasional day of enjoyable work.

Don't figure on the profit of the sticks that you are going to cut; there is profit indirectly on your surroundings accruing from such planting which defies all strict financial calculation, besides your own satisfaction, which will surely reflect from such work beyond any direct money gain, though this will not be lacking either, in proper time. It has been proved over and over again that a good wood-lot will sell the farm, if sold it must be, at a better price than it would have brought without it.

And you who are the happy owner of a wood-lot, treat it as the goose that lays the golden eggs; the eggs will soon be high in price; the goose is worth caring for. If you cut, don't cut the good trees only and leave the bad ones to spoil the looks of the lot and to injure the young growth, that would be better off if the gnarly old fellow overhead did not stand in its way with shade and drip. Always give some light and room to the young growth.

Forestry means more than tree-planting; it is the art of managing a wood crop so that it will reproduce itself spontaneously by the seed from the old trees and afterwards helping the young growth to make the best timber in the shortest time. Nature will reproduce the forest and grow timber without care if allowed by man, but she takes time, and time is money, at least to a careful man and manager.

Then use your odd moments in improving your crop; the ax, too, is a cultivator in judicious hands.

(2) *What interest has the farmer in forestry?* More than he knows. The wood-lot is to the farm what the work-basket is to a good housewife, with which she improves the odds and ends of time that the main business of the day allows, especially in winter time.

Now, it is possible that you can get for the timber which your grandfather has left you untouched $50 or $100 per acre from a hungry saw-mill man. Down come at once the old trees that it has taken one hundred and more years to grow; and, in nine cases out of ten, what is left? A useless piece of ground which reduces considerably the value of the fields lying near. Had you, instead, considered this wood-lot as a savings bank from which you could draw in interest every year what you need, taking care that the young growth was properly protected against cattle and fire and against damage from inferior kinds of trees, you would have a better kind of investment than the loose dollars which resulted from the sale.

May be your wood-lot was on a hill-side where the spring that waters your cattle gets its waters from, or where the brook that runs your millstones rises. And lo! the spring runs dry half the year, and the brook too, or else it breaks out in spring freshets, and the dollars which you got from the forest above you have to spend on repair of damages below.

There is no imagination in this; these are occurrences everywhere, and experience is growing in this country which shows that the forest is a useful regulator of water supply—the water reservoir of the farm.

The farmers must have more interest in keeping a proper proportion of the country under forest cover than any other class of citizens, for they depend in their business greatly upon a proper water supply, and for this the forest does admirable service.

You are, or ought to be, husbandmen not only of the soil but of the water capital of the world also. Do you realize that each acre of your fields requires from one to two million gallons of water to do its duty in growing crops during the season?

(3) *Water and forestry.*—The amount of water in the world does not change; it will probably always remain the same, but its distribution is changeable and can be changed by the operations of man. There is one part of the water capital of the world which is in constant circulation. Now we see it suspended as clouds in the air, now it pours down upon the earth, partly to run off over the ground into brooks and rivers to the sea, partly to sink deep into the ground and run in underground channels to places where it appears as springs, and another part remains in the ground for awhile, to be evaporated under the sun and by the action of the plants (pumping it up and transpiring it) and thus to be returned into the air. There it combines again with the water evaporated from the sea, the lakes, and the rivers, to form again clouds and to again pour down as rain and go through the same course.

Now, the skill of the farmer is to utilize this water capital for his crops to its utmost as long as he can control the flighty element. It is for this mainly that he plows the ground and cultivates it, weeds or no weeds, for the plowed ground absorbs more and evaporates less water. Yet in many places there are seasons when he can not with all his work manage to keep the water supply in a satisfactory state, and a water reservoir from which he might supply deficiencies would be most welcome.

The forest, with its spongy humus cover and its tendency to condense the moisture of the atmosphere and to induce it to fall as rain, the forest which prevents by its shade the rapid evaporation of the water in the soil and the rapid melting of the snow is the most inexpensive water reservoir for the farmer. It feeds the springs and brooks and by gradual filtration through the soil keeps the ground water level high enough to be useful in supplying the upper soil strata and the crops with moisture.

Therefore, keep a part of your farm under constant and dense forest shade; use the trees, but see to it that a dense new growth will shade the ground immediately. Thus you will avoid droughts and freshets and you will utilize the water capital where it is within your reach, instead of wasting it in the floods.

(4) *Is forestry profitable?* This question can be answered in the same way as the question, "Is agriculture profitable?" To some it is, to others it is not. It depends entirely on circumstances and local conditions and on the manner in which you carry on business. On the plains and prairies people who have tried to make forestry pay are well satisfied with the result. Not only have they gained in comfort and in benefit to their fields, but the actual material return on their expenditure for forest planting begins to satisfy them that "it pays."

To show you that forest property and forestry is likely soon to be more profitable in every part of the country let me give you some points for calculation.

The entire surface of this great country contains at present less than half a billion acres of woodland out of nearly two billion acres of surface. If this were all good timber there would grow upon it from 50 to 60 cubic feet of wood per acre every year; but you know there is a great deal of waste brush land and worthless thinly-stocked growth, so that we can not count on more than perhaps ten billion cubic feet yearly growth on the entire area. Now, how much do we use each year? There are 175,000,000 cords alone burned up in our stoves, in spite of all the coal that is used besides. We use every year for repairs and new fences enough posts and rails to make a fence containing 40 cubic feet of wood to the rod along the entire land frontier of the United States; the railroads need yearly as much ties and timber as will build 200,000 good-sized barns, and the lumber cut yearly will cover the whole field area of Connecticut with a tight half-inch floor, or if made into one-quarter inch stuff would cover out of sight the entire State. Altogether we use up annually over twenty billion, feet of all kinds, or probably double as much as there grows yearly in the whole country, and our population is increasing in an accelerated ratio and with it our needs. What must be the consequences? Reduced supply, increased demand, and higher prices.

It takes many years to grow a tree of size. The man who plants now will have a tree worth cutting in the time of high prices. Therefore, if you have a wood-lot, hold on to it and work carefully. If you have a waste corner, plant it to trees; it will surely be profitable.

WHAT IS A TIMBER TREE?

In response to a letter of inquiry from the Commissioner of the Land Office, who is called upon to decide cases of timber-culture claims or timber depredations, the following letter was written.

which may be of sufficient general interest to be here reproduced in substance :

The timber-culture law was unfortunately not framed with a knowledge of what forest planting on a semi-arid treeless plain implies, and even now we are not yet prepared to decide which are the best methods for forest planting in those regions, nor which are the best trees to plant with a view to ultimate results.

The trees which have been used and recognized as in compliance with law are not always the most desirable ones, if other objects than the mere possibility of growing them easily in a sub-arid region are to be considered.

Yet it would be possible and desirable, with the present state of our knowledge, to formulate such regulations for the guidance of the settler as will leave no doubt in his mind at the beginning as to what methods he may be allowed to employ and what trees will be recognized as meeting the requirements of the law, so as to avoid any hardship arising from unintentional failure to satisfy the expectations of the officer of the Land Office.

If the intention of the timber-culture law is simply to produce a soil cover by tree-growth, the wood of which may be useful, any tree that will grow answers the law, for all can be grown for their wood, and the wood of all is used wherever it occurs in its native state or is planted, even that of the fruit trees. The reason that in some localities a tree is grown for a certain purpose other than that of wood production, would not in itself be sufficient to exclude it from the list of available timber trees.

If the intention of the law was a wider one, namely, to produce a forest-growth of valuable t mber, then the list of available trees would not only shrink considerably, excluding even the everlasting Cottonwood, the indiscriminate use of which has done much harm, but, furthermore, it would become necessary to divide the number of permissible trees into two classes, principal and secondary trees : the first class representing the main crop of value, the second class, very important for its purpose, serving as shelter, nurse, or filling wood.

Of the kinds generally used so far we would class as principal Walnut, Black Cherry, Ash, Locust, Honey Locust, Pines, Spruces, Cedar, and perhaps Catalpa. As secondary or filling wood we would class Box-elder, Soft Maple, Elm, Osage Orange, Mulberry, and those of the first class also, which, like Red Cedar, Spruces, and Catalpa will endure shade, may assume the character of secondary or shelter wood.

Several considerations determine the classification, which it would lead too far to discuss here, but if such classification should be made it would also become necessary to determine the proportion of second-class trees which may be considered permissible.

With these preliminary remarks it will be possible more intelligently to discuss the question proposed:

IS THE RUSSIAN MULBERRY OR ANY MULBERRY TREE A TIMBER TREE?

THE KINDS.—In addition to our native large Red-fruited Mulberry (*Morus rubra*) and the small Mexican Mulberry (*M. microphylla*) a number of varieties under various names have been introduced extensively. There has been considerable confusion in the nomenclature of the Mulberries. The best authorities, however, recognize now only two Asiatic species, which, probably, by natural and artificial cross-fertilization have produced the great variety of forms, differing in their characteristics according to the preponderance in their composition of the one or the other type. These typical species are:

(1) The Black-fruited Mulberry (*Morus nigra*), of robust texture, with thick bark, hard, thick, rough, and downy leaves rather broader than long, and from its late budding adapted to northern climates.

(2) The White-fruited Mulberry (*Morus alba*), of a more delicate constitution, with thinner bark, leaves thin and smooth on both sides somewhat elongated, and less adapted to northern climates.

Sometimes described as species or classed by different writers under either of the two types as varieties, are *Morus tatarica*, *multicaulis*, *Morettiana*, *Indica*, *Constantinopolitana*.

The typical species are both of Asiatic origin, and to which the name "Russian Mulberry" should be given is questionable. The tree which the German immigrants from southern Russia introduced into Kansas in 1875 is probably the so-called Tatarian, the exact position of which in respect to the two types is not definitely ascertainable; by some it is classed as a variety of *M. alba*, by others again as a hybrid of the two types.

SIZE.—*Morus nigra*, in the climate of France, has attained a height of 40 to 50 feet in as many years, and a diameter of 10 to 12 inches. In England trees three hundred years old exist. The best records in that climate give not over 40 feet, and more frequently below 30 feet in height, and from 1 to 3¼ feet in diameter.

Morus alba is reported as attaining from 30 to 45 feet and 1 to 3 feet in diameter in cultivation in Europe. Records of trees of the so-called Russian Mulberry grown in Kansas are extant, showing a growth of 8 inches in diameter and 16 feet in height in six years. A tree measured by the writer near Fairbury, Nebr., being eight years old, measured 8 inches in diameter and 20 feet in height. Measurements reported from Brownville, Nebr., give the diameter at twenty-five years of age as 16 inches.

In its native country these species are claimed to attain a size of from 50 to 60 feet in as many years, and diameters of 3 to 5 feet.

Morus rubra attains a height of 60 to 70 feet and a diameter of 3 to 4 feet, exceptionally 7 feet.

TIMBER VALUE.—*Morus nigra* is said in France to produce wood of but little value except for firewood, and has been mostly propagated for its fruit.

Morus alba is said to be better than *nigra* for props, posts, rails, cooperage, carriage work, and firewood, and is somewhat similar to Black Locust. It has been planted mostly for silk culture, for which it seems the best species.

Morus rubra produces a tough, durable, fine-grained wood, used for fencing, tool handles, cooperage, and boat-building.

FOREST VALUE.—All Mulberries are rapid though not persistent growers, and are desirable in forest growing for "filling wood" or secondary timber, as they shade the ground well and endure shade tolerably. They are especially valuable in Western planting for this purpose, on account of their easy propagation and their capacity of enduring cold and drought. In this respect the *nigra* varieties are better adapted to the northern, the *alba* to the southern parts of our prairies.

The native species, "Red Mulberry," seems preferable in all respects to the introduced species, being as hardy if not hardier than these, a rapid and more persistent grower, and producing better wood.

The ease of procuring the plant material alone seems to excuse the use of the foreign species for forestry purposes, while their eventual use for silk culture does not enter into our consideration here.

CONCLUSION.—The Mulberries must be classed as timber trees, where they can attain a height of 16 to 20 feet, and are as such decidedly superior to the Cottonwood and Box-Elder, which have been so considered. Where the northern limit for the hardier varieties as timber trees will be can not yet be stated, probably not above 43° north latitude.

It is, however, possible to treat the Mulberry, like all other trees, as hedge plants, and the use of the foliage of the foreign species for silk culture would be likely to induce such treatment in order to facilitate the harvest of the foliage.

The apparent intention of the planter and his manner of treating the plantation would have to be considered before passing judgement, whether timber culture or silk-worm food is contemplated.

WHAT CONSTITUTES A TIMBER TREE?

This question may be put and therefore answered from several points of view.

Scientifically speaking, we should consider as a tree any woody plant the seed of which has the inherent capacity (potential energy) of growing naturally and under favorable conditions with one main erect axis (single stem), not divided at or near the ground (bearing a crown). Woody plants which do not possess that inherent capacity of growing with a single undivided stem naturally should be classed as shrubs.

Practically speaking, the region in which the plant is grown and the size to which it can attain in that region according to its inherent capacity, must be taken into account

If the definition is more specially to refer, not to "what is a tree?" but "what is a *timber tree?*" the purpose for which the plant is used enters into the consideration.

As to the size which should determine the appellation of "timber tree," this must necessarily be arbitrary and depends on the point of view from which the question is to be answered.

The botanist of the Department in making a collection of the forest trees of the United States has admitted only trees "which under favorable circumstances attain a height of 20 feet and a diameter of 4 inches. Yet, in a few cases, in order the more fully to illustrate a family, a tree has been admitted which would fall below that standard."

Dr. F. B. Hough places the height arbitrarily at 15 feet. Dr. Asa Gray, in his text-book in 1862, required a tree to have five times the human stature. In the sixth edition, in 1879, he says: "Trees are woody plants with single trunks, which attain at best four or five times the human stature. Yet the name of tree is not to be denied to a woody plant having a single and stout trunk of less altitude."

Dr. A. Wood calls a tree a woody plant with the lower part (trunk) unbranched, many times greater than the human stature.

Prof. C. S. Sargent, in his "Catalogue of American Forest Trees," recognizes woody plants with single stems, with a height "rarely exceeding 4 meters" (13.2 feet) as trees.

From these authorities it appears that the size is not only arbitrary, but not settled even in the minds of the writers, lacking a rational basis.

The forester will consider worthy of his attention any tree, no matter what size it attains, which can be made useful for forestry purposes. He classifies the forest trees into principal and secondary; the first class to form the main crop, the second to serve as soil cover, nurses, or to fill in between the main crop, or else of so little value as to be rarely used for forestry purposes. The classification can not of course be a fixed one, and changes according to locality. Thus the Black Locust and Catalpa, which had hitherto been of secondary significance in forestry, have become of primary importance in the sub-arid climate of western prairies, and the Cottonwood, which has been so widely planted, should never have risen to that dignity.

The lumberman will call a timber tree any tree that has grown to suitable size and quality for timber purposes. What that size is we have no fixed standard for determining. It changes not only with the species and the use to which it is put, but also according to the amount of available supplies. Thus, while ten years ago nothing in the White Pine region that would not square 1 foot at the small end was considered fit for lumber, now trees of 8 inches diameter and less are taken.

For the purpose of forest police (law) I would propose at the present stage of our conception of forestry, that as a timber tree should be classed any tree (from a seedling to a full-grown tree) which in the locality where found is generally and commonly put to useful application on account of its wood having grown or being capable of growing to useful size. Therefore, the Mesquit in New Mexico, which hardly attains tree size, should before the law in a trespass case be considered a timber tree. And in the estimation of timber trees on timber-culture entries any tree that, according to our present knowledge, is capable of attaining or may reasonably be expected to attain in the locality where planted suitable size for timber purposes, being elsewhere used for such purposes, should be considered a timber tree.

The word timber originally meant building material, and then, by extension, wood suitable for constructive purposes, size and quality entering as desiderata. But I believe that this restricted meaning has not been before the minds of our law-givers when using the term, and that it was rather in contradistinction to ornamental and fruit trees that the term was used, meaning trees which are grown for their wood, as a crop and for forestry purposes, in fact forest trees, and deriving its meaning from the applied signification of timber for woodland or forest.

So far, I believe, definition may go in general. In special cases circumstances may justify a different conception of the term. Thus it may be a matter of controversy whether an old hollow oak shall be considered a timber tree, though nobody doubts that the species oak is a timber tree. In this case the usefulness of the remnant of the tree will enter into the decision whether it was a timber tree under the law.

But in criminal cases the value is of no account, and a stricter application of principles of ownership rights in the protection of forest property is one of the most urgent needs of forestry. No matter what value my possessions may have, whether in the house, the field, or the forest, any man who deprives me of what is mine is a thief, and the more difficult it is to protect my property the stronger and more efficient protection should be given by the law. The criminal law stands for principle and right, the civil law for material value and damages. This idea needs to be impressed on our judges and jurors.

The days of pioneering are over in most of our States, and where they still exist offenses against the right of ownership should be condoned only under stress of urgent necessity. A man who cuts a stick from my grounds does so at the risk of my asserting my ownership right, and whether the stick be of value or not, before the criminal law I should be able to get my right vindicated. This understood, a long step forward to lawful life and to forest preservation will be made.

To enlist the interest of colleges and educational institutions in forestry work the following circular was sent out, in response to

which many replies were received, and Mr. M. G. Kern, one of the agents of the Department, has devoted his time to this correspondence:

A CIRCULAR TO EDUCATIONAL MEN.

The Forestry Division of the Department of Agriculture, primarily created to promote a popular understanding of the vital interests which are centered in the forest wealth of the United States, has directed its principal effort hitherto towards investigating the conditions of the forest areas of the country and the rapid decrease of the most valuable sources of supply, and has shown the need of inaugurating a new system of forest management and reproduction, by which alone the perpetuation of an ample supply of forest products, so vital to national prosperity, can be secured.

The array of statistics collected and reported already by this agency should suffice to awaken greater popular interest in the solution of so momentous a national problem than has thus far been manifested.

Hitherto we have destroyed our forests for the sake of immediate pecuniary gain or convenience, with reckless disregard of consequences or of the future supply of a material so valuable and even necessary for almost all pursuits and for the comfort of all classes. The history of other countries, which by the denudation of their forests have lost their agricultural fertility and which have suffered also from great climatic changes, should be sufficient warning to an intelligent people like ourselves to guard against a similar experience by taking measures in season to arrest the course of destruction which has prevailed and to adopt a system of wise forest conservation.

In marking out the line of future work to be undertaken by the Division of Forestry, the Commissioner of Agriculture deems it of great importance that those to whom the shaping of the intelligence of the coming generation is intrusted should be specially invited to take a calm consideration of this long-neglected subject.

Schools of every grade, without departing at all from their proper work, can supply some practical lessons in regard to the object and use of forests, the nature and growth of trees, and the significance of their existence or absence, awakening thereby the interest of pupils in a kind of knowledge too little fostered in the schools of the agricultural classes.

In schools of the higher grade it can be united with instructions in botany and natural history in general. In colleges forestry should be presented in lectures on its various relations to arboriculture, agriculture, and political economy.

Engaging thus the popular and higher education, we may establish a popular system of forestry suited to the peculiarities of our country and its people. We shall foster at the same time sympathy with rural objects, which will tend to make our youth content with rural life, instead of being overcome by the attractions of the great cities.

The Commissioner calls special attention to the value of object lessons in any branch of study, and recommends to all heads of the higher educational institutions, as far as in their power, to cause the grounds of their respective institutions to be planted with collections of forest and ornamental trees and shrubs, grouped in accordance with their botanical relations or with a view to successful growth by a system of judicious mixing of kinds for mutual protection.

A general adoption of this recommendation would soon convert the much neglected grounds surrounding our colleges and schools into park-like groves of great attraction, the exponents of correct taste in ornamental planting and perpetual volumes of forest botany and arboriculture.

In like manner might the study of botany be promoted and popularized by the culture of representative kinds of plants united in accordance with their systematic relationship. Botanical parterres of plants, both economic and ornamental, might easily be introduced into the school grounds of the country, through which much useful information, both practical and scientific, would be imparted, assisting rural life in its onward course to a higher plane of culture.

The Commissioner will take pleasure in promoting the adoption of his recommendation, as far as in his power, by contributions of plant material, and has especially instructed the western agent of the Forestry Division, Prof. M. G. Kern, of Saint Louis, Mo., a professional landscape gardener, to correspond with all who desire further information or advice in the design and improvement of the grounds of educational institutions.

If this recommendation meets with your favor, and you desire to avail yourself of the proffered aid, please fill out the inclosed blank and return it with your reply.

During the summer of 1886 the writer undertook, at his own expense, a journey of inspection over the Rocky Mountain region, in order to get personally acquainted with the region, which to the National Government must be of greatest immediate interest as regards forestry, for the bulk of the public timber is located on those mountains, and its devastation and destruction, which has for years gone on practically unchecked, has a most serious relation to the agricultural development of the valleys below, which is largely dependent upon irrigation, as also to the mining industry and the welfare of the entire region.

The journey having been undertaken in connection with meetings of the American Institute of Mining Engineers, an excellent opportunity was given to meet and ascertain the views, opinions, and needs of one of the most intelligent classes of the population—those engaged in mining—and thus the writer has been able with more personal knowledge to edit Bulletin No. 2 from the Forestry Division. This bulletin, at present writing in the hands of the Public Printer, will contain a detailed account, by counties, of the forest conditions in each of the Rocky Mountain States and Territories, and a complete exhibition of the forest flora of the region, accompanied by a key enabling even the uninitiated to acquaint themselves with the appearance, name, and use of the trees of this locality. Other papers and notes are added, by the aid of which an appreciation of the forests in the region may be obtained, as also a basis for the legislation required at the hands of the national legislature.

As the continued existence of these forests of the mountains is of the utmost importance to the agricultural development of the region, and on that account of interest to the whole country, it has been deemed expedient to present their location on the accompanying map, together with the location of the principal irrigation ditches in existence at the time.

The condition of these forest areas and their relation to watersheds are more fully noted in the special bulletin referred to, and in this place it is only necessary to state that the bulk of these lands is still in the hands of the General Government, and that to the protection and proper administration of them the practical forestry work of the Government should first of all be directed.

The desirable legislation for such action on the part of the Government, outlined in my last year's report, has been more fully formulated after the personal inspection of local conditions afforded by my journey alluded to before, and is comprised in a bill providing an administration by which the Government forests may not only be protected against fraudulent practices and against the ever-raging forest fires, but which also recognizes the local needs for wood and lumber and provides for their sure, honest, and ready supply.

The essential features of this bill, which has been submitted to Congress through the agency of the American Forestry Congress, are as follows:

The withdrawal from sale or other disposal of all woodlands still in the hands of the nation and the classification of the same into three classes is provided for.

The lands found to be of agricultural value, but wholly or partially timbered, are to be open to entry under the homestead or other laws, but an appraised value for the timber shall be paid by the settler, excepting for the timber on five acres, which he may hold under a "settler's license" without any payment other than a nominal

license fee of $2. The timbered lands on the headwaters of streams or other timber lands unfit for agriculture shall not be sold, but the timber on the same may be disposed of under a system of licenses.

The sections of the bill providing for these licenses are perhaps the most important part of the proposed legislation, and as they are novel in their form are here given in full:

SEC. 10. That the disposal for domestic purposes shall be made by means of licenses as follows, namely:

(1) A prospector's license shall be granted to any applicant by the local (district) inspector upon the payment of two dollars. Such license shall confer the right to prospect for minerals upon land falling under the provisions of this act, and also the right to cut, without waste and under the general regulations of the forestry board and the supervision of the rangers, timber for the first construction of shanties, prospecting shafts, and other necessary structures from the territories nearest to the prospector's claim or claims. Such license shall be good only for the district in which it is taken out, and shall end at the expiration of one year from the time of its issue, or whenever, sooner than that, the claim is perfected or the prospecting is abandoned.

(2) A settler's license shall be granted to any bona-fide settler having no timber on his claim by the local (district) inspector upon the payment of two dollars. Such license shall confer the right, for one year, to cut for the licensee's own use only and for domestic purposes timber, fuel, and fence material, without waste and under the general regulations of the forestry board, upon an area of five acres which the licensee may designate near his settlement.

(3) A timber license shall be granted to any bona-fide settler or mine operator or manufacturer, for the purpose of allowing him to supply himself or others with timber, fence material, or fuel, upon the payment of a license fee of five dollars and the further payment before beginning to cut any timber of a sum equal to one dollar for each and every acre embraced in his license, and in addition, a stumpage of not less than one cent per stump actual count, before the removal of the timber. Such license shall be granted for one year and shall confer the right to cut the timber on not less than forty nor more than eighty acres, the same to be selected by the applicant and the selection to be approved by the local officer.

SEC. 11. That all licenses provided for in section ten shall be in printed forms, and shall be issued, upon an order from the district inspector, by the receivers of public money upon the payment of the license fee. Licenses shall be numbered in succession, as applications for them are made, and priority of application shall determine the order in which they are granted. The district inspectors shall receive applications for license on certain days of each week, to be published and made known by them. They shall keep open books, in which shall be recorded in proper order applications for license and the action taken upon them, with the names and residence or post-office address of the applicants. The inspectors shall also notify the rangers of each license granted in their ranges, and the rangers shall be required to aid licensees in locating their claims. No unused "settler's license" or "timber license" shall be renewed unless good cause is shown for its not having been previously used, nor shall any license be granted to any person who in the use of a previous license has not complied with the regulations of the forestry board. No licenses of any kind shall be transferred from one company to another and continue to be valid unless the transfer of the same is authorized by the forestry board.

SEC. 12. That timber on lands of the first class, which is not needed for mining or agricultural development in the neighborhood, shall be disposed of to lumbermen or others, as it may be applied for under a "lumberman's license" in quantities not less in amount than that standing or being on one section nor more than that being on twenty-five contiguous sections. Such license shall be granted upon the payment of a fee of twenty-five dollars, by the Commissioner of Forests with the approval of the Secretary of the Interior, under the conditions set forth in section thirteen of this act, and shall confer the right to cut timber and sell the same from as many sections or acres as have been located and paid for. The licensee shall also pay one dollar per acre for the whole number of acres covered by his license, before he may begin operations and not later than six months after the granting of said license. And a further charge of not less than one cent per cubic foot shall be paid by the licensee after the timber has been cut and before the same is moved. Such license shall be good for two years, and in all cases in which not more than ten sections of timber are embraced in the license it shall not be renewed more than once for a longer term than two years. Where the license embraces more than ten sections of timber the same rule shall apply in regard to its renewal as in the case of licenses for a less amount of timber, except that for every five sections above ten embraced in the license there

may be a renewal of the license for one additional year. No licensee shall be authorized to apply for or take out a second "lumberman's license" until he shall have cut and disposed of three-fourths of the timber to which he is entitled by the license previously given.

SEC. 13. That all applications for "lumberman's license" are to be made to the Commissioner of Forests and must be accompanied by a statement of the location and approximate amount of the timber sought by the applicant, together with a certificate of the local forest inspector to the effect that the lands on which such timber is situated are of the first class and not covered by any of the local licenses as provided in section ten, nor presumably needed for such within a reasonable time. Such applications shall be considered in the months of August and September only, and no license shall be granted before at least three months have expired from the date of application and the same has been advertised three times in three local papers, if there be so many, of the district in which the licensee intends to locate. If the same location is sought by more than one applicant, priority of application shall not rule as to applications made in the same month, but the application for the smallest location shall, in such case, receive first consideration. And wherever a survey of the location is necessary the applicant shall pay half of the expense of such survey, and whenever the licensee begins operations upon his location he must notify the local forest inspector, and all cutting and disposal of the timber and other forest products shall be done under the supervision of the local inspector and in accordance with such regulations as the Commissioner of Forests shall prescribe.

To insure a proper administration of such a law, to prevent waste and loss by fires, and to establish the nucleus for the future forestry system of this great nation which we must ultimately adopt, a new bureau in the Department of the Interior is proposed, with a forest commissioner and four assistant commissioners acting as a forestry board. A division of the forest lands and forest reserves remaining under the control of the forest board into districts of proper size, and a thorough organization of a local service with forest inspectors and rangers, is also provided.

This is no doubt a thorough-going reform of the present settlement and disposition laws, which the Public Lands Commission of 1883 has characterized as "the cancers that destroy the public timber lands."

None but such a thorough organization can be expected to guard the national property, of which under the present neglect the nation is annually robbed to the extent of from $5,000,000 to $10,000,000, not counting the damage done by fires, the passing of timber lands by fraud into the hands of speculators, and the amount of timber which is legally obtained by railroad companies and others.*

* The records of the Land Office, from which the following figures are taken, show for the years specified the extent of the depredations upon the Government timber lands, so far as actually reported, the sums recovered by prosecution and fine or otherwise, the amount appropriated for the protection of the public forests, and the number of Government agents employed for that purpose. The value of timber stolen but of which no report has been made to Government can not be estimated with anything like accuracy, but it must be large:

Year.	Value of timber reported stolen.	Amount recovered.	Appropriation for protective service.	No. of agents employed in the aggregate.
1881	$891,888	$41,680	$40,000	17
1882	2,044,278	77,365	40,000	31
1883	8,144,658	27,741	75,000	25
1884	7,289,854	52,108	75,000	26
1885	2,862,530	49,451	75,000	23
1886	9,339,679	101,086	75,000	21
1887	6,146,935	128,642	75,000	26
	36,719,935	478,073	455,000	27

But, as has been stated repeatedly, the forest cover in the localities in which the bulk of the public timber lands is situated, notably on the Rocky Mountains and the Pacific slopes, subserve a function which makes its material value of only secondary importance. It has become already evident that the denudation of mountain sides in the region under consideration has impaired the regularity of waterflow, upon which irrigation in the arid valleys below depends. Preserved in continuous reproductivity, the natural forest cover presents better and cheaper water reservoirs than the artificial structures which are already talked about and for which millions of dollars will be asked by the irrigators and ambitious engineers.

Shall we never learn from the experience of others? Are even the unmistakable results of forest destruction exhibited in our sister Republic (France) of no avail to teach us wisdom?

In France, too, where forest devastation had wrought untold misery to the people and damage to agricultural conditions, the construction of vast reservoirs to retain the surplus waters in flood time, the construction of stupendous dams, or the embankment of river courses were suggested as remedies for the evil. But these were soon found not only to be impracticably costly but to create new dangers, perhaps greater than the old, since the mountain reservoir might burst at any time and the embanked river was certain to rise to a dangerous level above the surrounding plain. The wiser plan of reforestation therefore was resorted to, with results which now have proved the wisdom of that measure.

Since the year 1860 the French Government, in co-operation with the local communities, has reforested over 250,000 acres of mountain lands at a cost of $30,000,000, the State paying one-half. In addition, about 200,000 acres of sand dunes have been brought under forest cover. It is estimated that $34,000,000 more will have to be expended before all the lands devastated by forest destruction will be recuperated. The total annual appropriation for the forestry department of France in 1887 was $5,000,000, of which nearly $700,000 is for the "conservation and restoration of mountain districts by reforesting and resodding."

Those forests also prevent or make less dangerous the avalanches and snow-slides, which already have begun to occur in yearly increasing number and demand their sacrifice of human lives and of destroyed property.

The interest of the nation, therefore, in properly administering this property reaches beyond that of any material advantage.

The Public Land Commission in 1883, recommending necessary changes in existing land laws, says: "The timber lands should be sold. Will not private ownership, self-interest, best protect this class of lands?"

If the history of old countries, if the condition of the forest lands in the older settled parts of our country have not shown that this is a fallacy we may never expect to learn from experience.

It is not the forest that is valuable and would appear worth his protection to the individual, but the timber which the forest yields. As soon as that is gone the value and the interest are gone for the individual. The individual man plans for his pocket and for his own short life. Only the collective and protracted life of the State is fitted to deal with the protracted life of the forest and with interests not measured by pecuniary considerations alone. The interest which the community has in the forest is transcendent. The continuation, re-

production, and protection of the forest cover is of importance to the continued welfare of the community, especially in the mountain regions, and the mountain forests will therefore be in safer hands with the community at large—with the State.

Let it not be overlooked that the State is not only the representative of the interests of the community as against those of the individual, but also of future interests as against those of the present; that the forest is a kind of trust, of which only the usufruct belongs to the present, and that to draw upon its capital is a perversion of the trust which can only be excused by direst necessity. Every civilized country has found, after severe punishment for not obeying the laws of nature, that private interest is not sufficient to protect this class of lands; that State ownership, or what is more objectionable and less effective, State supervision of private forest lands, is indispensable in those regions where the forest subserves other functions than that of mere material supply.

In these mountain forests, in this legislation for their proper administration, lies the immediate national interest in forestry.

The individual States will have to guard their own forestry interests. That this must necessarily be so has already been recognized by several States, as will appear from the accounts given further on in this report.

TRADE NOTES.

The inquiries received by the Division for information regarding timber supplies and their location have grown more and more frequent of late. There is no precise knowledge to be had as to the quantity of pine timber still standing, nor is there any knowledge to be had in regard to timber supplies of any kind and their location, upon a mercantile basis. The collection of such knowledge, which would at once place the lumber and wood-working business upon a proper basis and remove the uncertainty of existing conditions of supply, should form an important branch of work in the Forestry Division, but to do this work thoroughly no adequate funds are provided, and in the absence of such the Division has made no attempts to obtain partial and unsatisfactory statistics. Better provisions for this branch of our national economy are sadly needed.

As to the consumption of wood material an approximation can be derived from the various trade reports.

An interesting compilation of the White Pine lumber product of the Northwest during the last fourteen years is furnished by the Northwestern Lumberman, from which it appears that the product has steadily increased since 1878 and is now double in quantity what it was then, namely, a total of 7,759,916,784 feet B. M. The shingle product adds nearly another billion feet to this grand total. In reference to this the president of the Lumber Manufacturers' Association of the West remarks:

> The figures quoted (and presumably correct) show that in fourteen years the lumber product of the districts embraced in the States of Michigan, Wisconsin, and Minnesota foot up the enormous amount of 77,635,022,329 feet, and that one-half of this has been cut during the past six years. This compilation of figures, compared with the forest statistics being now compiled by the Government for the information of the public, will demonstrate without argument two features that pertain to the lumber business: First, that the waste of timber has been without a parallel in the history of commerce; and second, the absolute necessity of guarding against such wholesale destruction of the forests as has been the custom in the past. In fourteen years there has been cut of pine alone 77,000,000,000 feet.

The following notes, of interest in regard to trade conditions, are gleaned from various "lumbermen's" papers:

The hustling for timber within the past two years has been great. It has almost approached a mania. All this means that the timber market of the country is now one of stability. The days of accessible excessively cheap timber are gone, and probably forever.

Although the price of White Pine stumpage has increased considerably, it is generally admitted that pine lumber is selling below its value with reference to the price of the raw material on the stump or to the actual investment in the manufacture. Prices will advance when the conviction becomes universal in the trade that it must, and this feeling can only exist as the result of a thorough knowledge of existing and prospective conditions. In the face of a glutted market over-production is insisted upon.

The greater part of remaining White Pine supplies in Minnesota are situated in Indian reservations, notably in the Red Lake Indian Reservation, belonging to the Indians. Strenuous efforts are being made to open up and control these supplies by obtaining the grant of right of way for the construction of a railroad through this reservation. While, no doubt, these stores of timber should at some time be utilized, wise statesmanship would retain them until a more thorough and rational utilization is assured through a change in the conditions of the markets.

The Sisseton Indians in Minnesota, who are in possession of the hard-wood forests covering the coteaux, the mountainous portion of that country, which contains many of the principal sources of the Minnesota River, are reported as cutting and slashing into them with the same indifference and rapacity that characterizes the white monopolists in their raids upon the forests around the northern sources of the Mississippi, helping with fire to make these hills and table-lands barren and robbing the lands beyond of the forests.

While Southern pine lands and cypress swamps have been taken up by Northern capitalists to such an extent that "Government pine has nearly passed into second hands, and those who may hereafter desire to invest in Southern pine will have to content themselves with scattering tracts or buying at considerably advanced prices," and while "no such phenomenal change in the market for timber lands was ever witnessed as that which has occurred in the South within a brief year," it is complained that so far this has not led to a notable development in the lumber business of that section. "The lumber business of the South will have to grow up very much as the Northern business did, with this difference, that there is a larger field of consumption preparing for it. Some day the Yellow Pine belt will be the chief source of supply for the Western country, and it will be more largely depended upon in all quarters. There is not the demand for Yellow Pine to warrant its manufacture now on the scale that White Pine is cut, and there will not be for a long time." On the other hand, reports show that the Southern pine is beginning to drive out the Northern in Kansas and other Western States.

California Redwood lands are worth at least twenty times as much as the pine lands of the Eastern States, owing to the vastly greater productiveness of the Redwood lands. Those who still hold immediately available timber-land are likely to get high prices, as those millmen who have not already got enough for their wants are now unable to find vacant or cheap lands. To-day one of the oldest and largest mill-owners in Humboldt County is paying $1.50 stumpage, amounting to $150 per acre, for land he could have gotten a few years ago for $2.50 to $5 per acre.

The supply of railroad material has become a leading item in the trade, the number of miles of railroad added during the last year being over 10,000, with an added indirect demand for lumber in car factories which is enormous.

The bulk of the smaller products of wood are still made in the East. It is beyond question, however, that there is an immense field available for them in the West. The pine business can not last forever. It has given out already in spots, and the places where saw-mills have finished their appointed tasks will increase in number every year. Smaller manufacturers, who require for their work a convenient supply of timber, are the natural successors of the men who cut the pine. Local points that are mourning the present or coming loss of their saw-mill business would do well to investigate the resources in the way of timber they have left.

It is not long ago that cedar was almost despised as a timber and the stumpage was without value in the market. But now it is admitted that the White Cedar is one of the most valuable of Northern timber growths. The market for it, as ties, poles, fence-posts, paving blocks, shingles is almost from one end of the country to the other.

In regard to the cooperage industry it is stated that while in 1883–'84 the export of the products of this industry amounted to over $4,500,000 the same has fallen off in the present year to somewhat over $3,000,000, and the cause is sought in the

action of the Spanish Government in reducing its export duty on sugar shipped in bags, by which the English bags and English shippers have beaten out the trade in American hogsheads, and, of course, the carriage of the same by some three hundred coasting vessels to the West Indies. This state of affairs is claimed as threatening to wipe out an industry employing thousands of men and "utilizing a class of lumber which is of no use for other purposes."

Of the Canadian cut of spruce in 1887, amounting to something like 300,000,000 feet, B. M., 170,000,000 went to the United States, as against 130,000,000 to Great Britain.

Pensacola shipped during the last year 1,036,650 cubic feet of hewn, 8,472,050 of sawn timber, and 15,126,600 of lumber, making a total of 24,635,300 cubic feet, of which 17,862,335 went to foreign parts (7,622,075 cubic feet to England), prices ranging from 10 to 12 cents per cubic foot. The foreign shipments show an increase over the previous year of 2,225,000 cubic feet.

Shipments from Mobile, Ala., show a decline in export trade, but a decided advance in coastwise and inland trade. The total shipment during 1886–'87 is reported as 2,445,520 cubic feet, of which a little more than 1,000,000 cubic feet was for export, a third of which goes to Cuba; the decline of the export trade, being fully 30 per cent. from that of the previous year, is explained by the greater home demand.

From Pascagoula, which is said to be second only to Pensacola in the export lumber trade, it is reported "that prices from first hands have increased fully 25 per cent. over those of last year, mainly due to the enhanced cost of production."

Large hewn timber, that a few years ago could be obtained close to the river banks, is now very scarce and must be hauled 10 to 12 miles to the streams, and the day is not far distant when such large timber will be unprocurable. Stocks of all kinds of wood are very light at all the Gulf ports; freights are firm and ruling much higher than last season.

These notes give glimpses of the directions in which the work of the Division should properly be extended. Resolutions have been passed at various lumbermen's meetings, asking for such appropriations from Congress as will enable the Division to take up this line of work, and many letters of inquiry from lumbermen and others show that such knowledge of forest and market conditions is expected of the Division, but so far it has been impossible to provide it with the funds at the disposal of the Department.

Exports of wood and wood products, 1880–'87.

Articles.	1880.		1881.		1882.	
	Cubic feet.	Value.	Cubic feet.	Value.	Cubic feet.	Value.
Fire-wood	387,600	$11,552	396,500	$10,947	347,400	$13,863
Boards, deals, and planks	23,767,000	4,223,259	26,717,000	5,192,961	33,954,583	6,887,080
Joists and scantling						
Hoops and hoop-poles, etc	5,339,800	427,187	1,308,662	104,693	1,166,975	93,358
Laths						
Palings, pickets, and bed-slats	*79,575	11,936	*150,350	22,552	*277,150	41,573
Shingles	760,354	165,893	851,060	173,026	854,910	187,606
Shooks, box	544,328	136,082	302,904	75,726	303 992	75,998
Shooks, other						
Staves and headings	*35,109,760	3,510,976	*31,369,140	3,136,914	*43,468,780	4,346,878
All other lumber	6,379,590	765,550	10,170,066	1,220,408	13,229,100	1,587,493
Timber, sawed						
Timber, hewed	16,365,346	2,219,320	22,961,618	3,329,443	24,491,354	3,570,160
Logs and other timber	9,874,100	789,927	11,042,600	883,407	16,020,412	1,281,633
Total unmanufactured	98,607,455	12,261,682	105,269,900	14,150,077	134,114,656	18,065,845
Manufactures of—						
Hogsheads and barrels, empty	349,372	262,029	207,550	155,662	378,735	284,051
Household furniture	2,205,171	1,653,878	2,525,612	1,894,209	3,122,921	2,342,191
Woodenware	441,516	331,137	440,762	330,589	500,251	442,688
All other manufactures	2,304,867	1,728,650	2,759,607	2,069,705	3,504,903	2,628,677
Total manufactures	5,300,926	3,975,694	5,933,531	4,450,065	7,596,810	5,697,607

* The estimates of cubic feet marked * are based upon the values given and not upon official reports of quantity, and are therefor to be taken as only approximately correct.

Exports of wood and wood products, 1880–'87—Continued.

Articles.	1880.		1881.		1882.	
	Cubic feet.	Value.	Cubic feet.	Value.	Cubic feet.	Value.
Naval stores:						
Rosin, Tar, Turpentine and pitch	.....	$2,452,908	.....	$2,638,804	.....	$3,370,357
Spirits of turpentine	.....	2,132,154	.....	2,414,719	.....	3,798,034
Total naval stores and spirits of turpentine	.....	4,585,062	.....	5,053,523	.....	7,168,491
Bark and tanning extracts	.....	210,126	.....	120,426	.....	97,442
Matches	39,749	119,246	37,389	112,167	53,822	161,466
Agricultural implements	.....	2,245,742	.....	2,400,318	.....	2,976,371
Sewing machines	65,975	1,649,367	75,293	1,982,324	105,900	2,647,515
Musical instruments	.....	811,177	.....	974,982	.....	1,267,450
Miscellaneous	105,724	5,035,658	112,682	5,590,217	159,722	7,150,244
Total	104,014,105	25,858,096	111,316,113	29,243,882	141,871,188	38,081,987

Articles.	1883.		1884.		1885.	
	Cubic feet.	Value.	Cubic feet.	Value.	Cubic feet.	Value.
Fire-wood	432,600	$15,552	254,016	$9,464	200,376	$6,985
Boards, deals, and planks	41,617,166	8,377,908	34,438,360	7,079,701	34,231,192	6,570,576
Joists and scantling			1,048,456	195,043	1,081,324	183,166
Hoops and hoop-poles, etc	1,737,300	138,983	4,455,900	356,470	4,332,450	346,598
Laths	*301,100	45,168	153,000	22,295	158,617	20,277
Palings, pickets, and bed-slats			114,540	15,615	174,881	2-,515
Shingles	938,826	203,779	857,141	183,521	637,042	132,976
Shooks, box	357,332	89,333	653,985	186,853	720,426	205,836
Shooks, other	*48,674,010	4,867,401	4,579,311	1,526,437	4,396,395	1,465,465
Staves and headings			40,297,200	2,686,473	29,261,100	1,950,794
All other lumber	13,063,600	1,567,631	8,135,000	976,191	9,841,200	1,182,142
Timber, sawed	19,913,220	3,102,232	16,704,331	2,247,328	12,770,667	1,609,485
Timber, hewed			10,615,065	1,735,382	8,411,066	1,289,281
Logs and other timber	31,757,962	1,540,637	21,307,900	1,704,635	21,147,200	1,691,780
Total unmanufactured	158,793,116	20,948,624	143,614,205	18,925,408	127,372,936	16,683,878
Manufactures of—						
Doors, sash, and blinds,†	.....	.....	393,256	294,942	378,688	284,016
Moldings, trimmings, etc.†	.....	.....	231,548	173,661	175,204	131,403
Hogsheads and barrels, empty	401,645	301,234	426,912	320,184	432,275	324,206
Household furniture	3,439,158	2,579,369	3,239,775	2,429,831	2,838,256	2,128,692
Woodenware	689,027	516,770	541,685	406,264	428,619	321,464
All other manufactures	3,263,615	2,447,711	2,299,784	1,724,838	2,120,952	1,590,714
Total manufactures	7,793,445	5,845,084	7,132,960	5,349,720	6,373,994	4,780,495
Naval stores:						
Rosin	.....	.....	.....	2,909,074	.....	2,198,267
Tar	.....	3,242,818	.....	91,284	.....	66,449
Turpentine and pitch	.....	.....	.....	118,842	.....	29,847
Spirits of turpentine	.....	4,366,229	.....	3,885,500	.....	2,690,231
Total naval stores and spirits of turpentine	.....	7,609,047	.....	7,004,700	.....	4,984,794
Bark and tanning extracts	.....	87,528	.....	292,851	.....	346,218
Matches	41,499	124,499	35,603	106,809	23,280	69,840
Agricultural implements	.....	3,883,919	.....	3,442,767	.....	2,561,602
Sewing machines	122,466	3,061,639	142,112	3,552,814	115,944	2,898,698
Musical instruments	.....	1,203,612	.....	1,079,118	.....	941,344
Miscellaneous	163,965	8,361,197	177,715	8,474,359	139,224	6,817,702
Total	166,750,526	42,763,952	150,924,880	39,754,187	133,886,154	33,266,869

*The estimates of cubic feet marked * are based upon the values given and not upon official reports of quantity, and are therefore to be taken as only approximately correct.

†Until 1884 the exports of doors, sash, blinds, moldings, etc., are included by the Bureau of Statistics in "all other manufactures," and can not be given separately. For the same reason the exports of some other articles can not be given separately for every year.

Exports of wood and wood products, 1880–'87—Continued.

Articles.	1886.		1887.	
	Cubic feet.	Value.	Cubic feet.	Value.
Fire-wood	261,408	$8,568	160,600	$4,975
Boards, deals, and planks	36,155,464	6,620,911	35,396,666	6,531,144
Joists and scantling	898,143	151,119	717,250	126,284
Hoops and hoop-poles, etc	2,804,850	224,385	2,673,150	213,852
Laths	295,8.5	48,377	221,008	32,940
Palings, pickets, and bed-slats	150,645	1 ',544	109,680	13,853
Shingles	581,996	103,049	541,016	101,282
Shooks, box	604,498	174,723	547,016	136,754
Shooks, other	3,295 041	1,198,444	2,815,515	938,505
Staves and headings	30,451,500	2,030,097	30,089,325	2,005,955
All other lumber	9,792,500	1,175,099	10,036,600	1,204,392
Timber, sawed	16,112,000	2,092,557	13,967,410	1,976,750
Timber, hewed	5,037,612	829,019	4,260,639	697,915
Logs and other timber	15,732,100	1,258,575	13,015,975	1,041,278
Total unmanufactured	122,173,652	15,934,467	114,551,850	15,065,879
Manufactures of—				
Doors, sash, and blinds *	356,007	267,005	364,437	273,328
Moldings, trimmings, etc.[1]	139,913	104,935	152,080	114,061
Hogsheads and barrels, empty	663,277	497,458	609,333	456,992
Household furniture	2,829,083	2,121,812	2,638,327	1,978,745
Woodenware	441,647	331,235	434,648	325,986
All other manufactures	1,848,531	1,386,398	1,973,257	1,479,943
Total	6,278,458	4,708,843	6,172,082	4,629,055
Naval stores:				
Rosin		1,963,091		2,301,636
Tar		36,208		39,772
Turpentine and pitch		32,999		29,270
Spirits of turpentine		2,811,777		3,489,985
Total naval stores and spirits of turpentine		4,844,075		5,860,663
Bark and tanning extracts		283,086		239,700
Sumac		13		
Matches	27,401	82,204	25,793	77,379
Agricultural implements		2,367,258		2,138,398
Sewing machines	103,388	2,584,717		
Musical instruments		871,446		831,837
Miscellaneous	130,789	6,188,724	25,793	3,287,314
Total	128,582,899	31,676,109	120,749,725	28,842,881

* Until 1884 the exports of doors, sash, blinds, moldings, etc., are included by the Bureau of Statistics in "all other manufactures," and cannot be given separately. For the same reason the exports of some other articles can not be given separately for every year.

Imports of wood and wood products, 1880–'87.

Articles.	1880.		1881.		1882.	
	Cubic feet.	Value.	Cubic feet.	Value.	Cubic feet.	Value.
Free of duty.						
Wood, unmanufactured, not elsewhere specified:						
Fire-wood	13,182,816	$266,044	14,165,952	$314,896	17,307,648	$390,748
Logs and round timber	4,373,400	349,872	5,420,400	433,630	7,370,100	589,610
Railroad ties	*3,565,983	213,959	*5,658,600	339,516	*13,351,983	801,119
Shingle and stave bolts	3,382,480	84,562	4,030,760	100,769	4,515,404	112,851
Ship timber	172,980	43,245	220,312	55,078	301,640	75,410
Ship planking	107,691	35,897	97,311	32,437	37,989	12,663
Wood pulp	.....	5,740	.....	6,541	.....	14,972
Hemlock bark	.....	476,149	.....	492,561	.....	490,341
Dutiable.						
Wood, unmanufactured, not elsewhere specified	154,024	19,253	196,048	24,506	1,219,752	152,469
Timber	49,854	6,222	69,202	6,166	258,377	31,374
Lumber:						
Boards, planks, deals, etc	39,542,864	4,763,441	43,149,002	5,656,830	45,553,086	6,608,547
Clapboards	931,937	19,759	775,003	22,590	1,050,030	37,353
Hubs, posts, lasts, and rough blocks	555,328	99,959	775,372	139,567	581,350	104,643
Laths	2,079,344	110,505	2,371,600	139,716	2,409,360	168,429
Pickets and palings	379,040	31,846	509,520	47,194	576,880	51,669
Shingles	823,788	116,608	1,207,472	186,297	1,388,156	244,620
Shooks and packing boxes	316,128	79,032	327,820	81,955	280,020	70,005
Staves	13,243	4,729	80,972	11,150	503,932	84,661
Bark extracts, chiefly hemlock	.....	22,863	.....	4,021	.....	90,545
Sumac	.....	588,911	.....	409,400	.....	461,441
Cork and cork bark, manufactured †	.....	104,808	.....	108,945	.....	120,312
Matches	4,959	14,879	6,000	17,676	745	2,234
Manufactures: *						
Casks and barrels		3,517		10,428		8,614
Cabinet ware and furniture		147,783		162,403		228,761
Osiers and willows, peeled and dried	1,209,945	21,833	1,573,265	36,259	1,884,977	44,952
Osier and willow baskets		142,214		246,449		266,915
All other manufactures		592,112		724,410		864,491
Free of duty.						
Cabinet woods: †						
Box	.....	27,563	.....	51,816	.....	48,991
Cedar	.....	465,169	.....	282,740	.....	330,962
Ebony	.....	84,354	.....	73,170	.....	72,344
Granadilla	.....	5,050	.....	4,723	.....	3,111
Lancewood	.....	14,655	.....	2,588	.....	10,634
Lignum vitæ	.....	28,343	.....	49,754	.....	60,839
Mahogany	.....	266,026	.....	383,243	.....	569,412
Rose	.....	178,578	.....	207,696	.....	260,767
Sandal	.....	3,400	.....	773	.....	702
All other cabinet woods	.....	306,354	.....	474,628	.....	315,410
Cork wood or bark, unmanufactured	.....	658,830	.....	787,933	.....	1,124,288
Total	70,845,804	10,403,044	80,634,611	12,125,448	98,591,429	14,927,209

* Estimated from values reported, actual measurements not being given. The principal object in the compilation of these tables has been to show the quantity of forest material involved in our exports and imports. All estimates of quantity are made on the basis of the cubic foot as a common standard. Where the reports from which these tables are compiled do not give quantities, but only values, the quantities have been estimated from the values. In the case of manufactures, such as barrels, cabinet ware, etc., articles are estimated to have one-third of their value in material, and this is reckoned as worth 25 cents per cubic foot. Round timber is reckoned at 8 cents per cubic foot, ship timber at 25. Shingles are estimated at 14 cubic feet per 1,000, and lath at 16 feet per 1,000.

† It will be seen by a comparison of figures that only about one-fifth in value of all importations of wood and wood products consists of articles not producible in this country.

Imports of wood and wood products, 1880–'87—Continued.

Articles.	1883.		1884.		1885.	
	Cubic feet.	Value.	Cubic feet.	Value.	Cubic feet.	Value.
Free of duty.						
Wood, unmanufactured, not elsewhere specified:						
Fire-wood	16,260,864	$397,391	16,249,824	$373,912	15,597,216	$338,806
Logs and round timber	7,673,100	613,847	5,617,300	449,382	4,811,800	384,948
Railroad ties	*10,377,617	622,657	6,764,359	382,710	3,850,301	187,168
Shingle and stave bolts	7,456,080	186,402	9,933,680	248,342	4,847,080	121,177
Ship timber	202,468	50,617	190,016	47,504	58,652	14,663
Ship planking	85,436	28,812	125,829	41,943	66,369	22,123
Hop-poles	.....	.....	323,200	40,399	150,200	18,780
Wood pulp	.....	19,132	.....	5,941	.....	9,637
Charcoal	.....	.....	.....	56,765	.....	47,354
Hemlock bark	.....	343,559	.....	364,410	.....	288,979
Dutiable.						
Wood, unmanufactured, not elsewhere specified	2,593,616	324,202	647,688	80,961	311,680	38,960
Timber	156,556	18,990	71,812	8,512	73,290	11,712
Lumber:						
Boards, planks, deals, etc	43,754,061	7,009,644	44,725,966	6,987,694	41,854,165	6,189,781
Clapboards	918,933	30,224	841,253	28,785	998,807	41,827
Hubs, posts, lasts, and rough blocks	370,111	66,620	337,167	60,690	327,993	59,039
Laths	2,779,648	205,513	2,982,784	257,529	2,477,008	199,819
Pickets and palings	510,400	60,494	375,920	57,596	375,920	51,027
Shingles	1,469,650	281,831	1,206,282	215,454	976,556	158,043
Shooks and packing boxes	149,784	37,446	336,264	84,066	280,060	70,015
Staves	109,538	27,410	1,040,546	280,150	942,318	253,703
Bark extracts, chiefly hemlock	.....	127,316	.....	31,686	.....	19,656
Sumac	.....	459,759	.....	668,440	.....	504,289
Cork and cork bark, manufactured†	.....	91,400	.....	158,419	.....	147,132
Walking-sticks	.....	.....	.....	14,560	.....	11,628
Matches	4,064	12,192	116,018	348,055	35,465	106,395
Manufactures:*						
Casks and barrels		2,576		1,896		1,494
Cabinet ware and furniture		283,291		295,064		268,810
Osiers and willows, peeled and dried	1,957,208	54,424	1,591,322	51,691	1,411,916	28,665
Osier and willow baskets		262,056		237,834		202,663
All other manufactures		865,559		607,007		557,305
Free of duty.						
Cabinet woods:†						
Box	.....	38,953	.....	83,921	.....	223,015
Cedar	.....	424,058	.....	568,866	.....	520,605
Ebony	.....	47,824	.....	63,614	.....	26,311
Granadilla	.....	814	.....	265	.....	432
Lancewood	.....	12,336	.....	7,051	.....	1,117
Lignum-vitæ	.....	101,305	.....	45,206	.....	8,698
Mahogany	.....	466,809	.....	772,710	.....	592,771
Rose	.....	313,348	.....	157,266	.....	52,306
Sandal	.....	10,529	.....	4,009	.....	654
Satin	.....	.....	.....	5,834	.....	5,984
All other cabinet woods	.....	455,814	.....	315,173	.....	226,491
Cork wood or bark, unmanufactured	.....	934,427	.....	935,871	.....	879,243
Total	96,830,134	15,299,481	93,477,230	15,147,292	79,446,796	12,893,405

*Estimated from values reported, actual measurements not being given. The principal object in the compilation of these tables has been to show the quantity of forest material involved in our exports and imports. All estimates of quantity are made on the basis of the cubic foot as a common standard. Where the reports from which these tables are compiled do not give quantities, but only values, the quantities have been estimated from the values. In the case of manufactures, such as barrels, cabinet ware, etc., articles are estimated to have one-third of their value in material, and this is reckoned as worth 25 cents per cubic foot. Round timber is reckoned at 8 cents per cubic foot, ship timber at 25. Shingles are estimated at 14 cubic feet per 1,000, and lath at 16 feet per 1,000.

†It will be seen by a comparison of figures that only about one-fifth in value of all importations of wood and wood products consists of articles not producible in this country.

Imports of wood and wood products, 1880–'87—Continued.

Articles.	1886.		1887.	
	Cubic feet.	Value.	Cubic feet.	Value.
Free of duty.				
Wood, unmanufactured, not elsewhere specified:				
Fire-wood	16,910,400	$349,134	16,464,288	$327,349
Logs and round timber	5,748,000	459,843	7,338,400	587,073
Railroad ties	7,265,685	377,443	8,424,833	484,945
Shingle and stave bolts	5,374,280	134,357	5,254,800	131,370
Ship timber	156,076	39,019	181,988	45,497
Ship planking	56,571	18,857	98,094	32,698
Hop-poles	100,000	12,511	26,224	3,278
Wood pulp	.....	5,897	.....	7,381
Charcoal	.....	36,849	.....	47,353
Hemlock bark	.....	236,198	.....	272,956
Dutiable.				
Wood, unmanufactured, not elsewhere specified	206,616	25,827	142,896	17,862
Timber	20,231	2,221	9,967	1,025
Lumber:				
Boards, planks, deals, etc	39,933,981	5,639,813	40,297,865	5,825,320
Clapboards	1,303,413	59,389	1,397,450	58,953
Hubs, posts, lasts, and rough blocks	337,161	60,615	260,867	46,956
Laths	2,457,216	198,756	3,051,728	241,077
Pickets and palings	406,080	61,318	388,800	32,907
Shingles	1,107,414	171,523	1,254,176	185,611
Shooks and packing boxes	421,796	105,449	463,996	115,999
Staves	1,002,716	269,961	1,129,258	304,031
Bark extracts, chiefly hemlock	.....	9,273	.....	51
Sumac	.....	564,276	.....	466,378
Cork and cork bark, manufactured †	.....	176,679	.....	209,532
Walking-sticks	.....	9,079	.....	8,101
Matches	11,396	34,187	8,486	25,458
Manufactures: *				
Casks and barrels	1,367,690	1,224	1,602,744	1,780
Cabinet ware and furniture		308,191		387,234
Osiers and willows, peeled and dried		15,164		18,516
Osier and willow baskets		238,380		312,179
All other manufactures		462,809		482,349
Free of duty.				
Cabinet woods: †				
Box	.....	72,403	.....	35,202
Cedar	.....	520,184	.....	263,825
Ebony	.....	69,043	.....	51,211
Granadilla	.....	2,807	.....	1,685
Lancewood	.....	16,910	.....	23,975
Lignum-vitæ	.....	42,362	.....	66,513
Mahogany	.....	479,861	.....	653,473
Rose	.....	46,957	.....	6,308
Sandal	.....	2,598	.....	1,339
Satin	.....	12,641	.....	9,528
All other cabinet woods	.....	219,585	.....	252,084
Cork wood or bark, unmanufactured	.....	891,392	.....	1,239,247
Total	84,186,712	12,461,985	87,796,860	13,341,609

* Estimated from values reported, actual measurements not being given. The principal object in the compilation of these tables has been to show the quantity of forest material involved in our exports and imports. All estimates of quantity are made on the basis of the cubic foot as a common standard. Where the reports from which these tables are compiled do not give quantities, but only values, the quantities have been estimated from the values. In the case of manufactures, such as barrels, cabinet ware, etc., articles are estimated to have one-third of their value in material, and this is reckoned as worth 25 cents per cubic foot. Round timber is reckoned at 8 cents per cubic foot, ship timber at 25. Shingles are estimated at 14 cubic feet per 1,000, and lath at 16 feet per 1,000.

† It will be seen by a comparison of figures that only about one-fifth in value of all importations of wood and wood products consists of articles not producible in this country.

Value of imported wood material and duties paid thereon for the years 1880–'87.

[Compiled from tables of the Bureau of Statistics.]

Articles.	1880.			1881.			1882.		
	Value.	Duty.	Ad valorem.	Value.	Duty.	Rate.	Value.	Duty.	Rate.
Tanning materials:									
Hemlock bark ... free.	$476,148	.....	.....	$492,561	.....	.....	$490,341	.....	.....
Other material, crude.	162	.....	.....	560	.....	.....	.....	.....	.....
Wood, unmanufactured, free	2,505,601	.....	.....	3,002,932	.....	.....	3,302,639	.....	.....
Paper pulp	5,508	$1,102	$20.00	15,087	$3,017	$20.00	24,926	$4,985	$20.00
Wood and manufactures of:									
Timber, logs, and spars, etc.	6,494	524	8.07	7,061	748	10.61	32,382	3,002	9.27
Hubs, posts, etc	119,212	23,842	20.00	164,073	32,815	20.00	257,199	51,432	20.00
Total wood, etc	125,706	24,366	19.49	171,134	33,563	19.51	289,582	54,434	18.79
Boards, planks, deals, etc.	4,763,441	921,901	19.36	5,656,830	1,000,371	17.68	6,607,538	1,046,194	15.83
Clapboards	19,759	4,303	21.78	22,590	3,855	17.07	37,253	5,297	14.23
Staves	4,729	473	10.00	11,150	1,115	10.00	84,661	8,466	10.00
Furniture, unfinished, osiers, etc	49,727	13,527	27.20	78,061	21,342	27.34	103,484	28,203	27.25
Total	4,837,656	940,204	19.44	5,768,631	1,026,683	17.80	6,832,936	1,088,160	15.93
Wood:									
Fire-wood ..... free.	266,044	.....	.....	314,896	.....	.....	390,748	.....	.....
Railroad ties ..... do..	213,959	.....	.....	339,516	.....	.....	801,119	.....	.....
Cabinet wares, finished	147,716	51,700	35.00	162,133	56,747	35.00	226,874	79,406	35.00
Laths, pickets, and palings	142,351	25,263	17.74	185,910	31,673	16.95	220,098	34,797	15.81
Shingles	116,608	20,595	17.66	186,297	30,187	16.20	244,620	34,704	14.19
Osier and willow baskets, etc	142,214	49,775	35.00	246,449	86,257	35.00	266,915	93,420	35.00
All manufactures of, n.e.s	674,660	232,003	34.39	816,794	281,298	34.44	943,110	326,157	34.58
Total wood manufactures	1,223,549	379,376	31.00	1,598,593	486,162	30.41	1,901,617	568,484	29.89
Total wood, unmanufactured ..... free.	2,985,604	.....	.....	3,657,343	.....	.....	4,494,506	.....	.....
Total wood and manufactures of, dutiable	6,159,086	.....	.....	7,496,816	.....	.....	8,967,29	.....	.....
Total value of all wood imported	9,144 690	.....	.....	11,154,159	.....	.....	13,461,797	.....	.....

Articles.	1883.			1884.			1885.		
	Value.	Duty.	Rate.	Value.	Duty.	Rate.	Value.	Duty.	Rate.
Tanning materials:									
Hemlock bark ... free.	$343,560	.....	.....	$364,410	.....	.....	$288,979	.....	.....
Other material, crude.	438	.....	.....	48	.....	.....	248	.....	.....
Wood, unmanufactured, free	3,545,016	.....	.....	3,556,819	.....	.....	2,982,569	.....	.....
Paper pulp	28,255	$5,651	$20.00	143,353	$14,335	$10.00	242,616	$24,262	$10.00
Wood and manufactures of:									
Timber, logs, and spars, etc.	17,189	2,834	14.77	11,458	1,270	11.08	11,712	928	7.92
Hubs, posts, etc	390,905	78,173	20.00	141,667	28,332	20.00	97,999	19,600	20.00
Total wood, etc	410,094	81,007	19.75	153,125	29,602	19.33	109,711	20,528	18.71
Boards, planks, deals, etc.	7,009,445	1,015,181	14.48	6,987,694	1,039,792	14.88	6,189,781	971,327	15.69
Clapboards	30,224	4,510	14.92	28,786	4,138	14.37	41,827	4,555	10.89
Staves	27,410	5,379	12.80	280,150	28,015	10.00	253,703	25,370	10.00
Furniture, unfinished, osiers, etc	129,353	35,093	27.13	184,767	26,858	14.54	149,340	19,780	13.25
Total	7,196,432	1,060,163	14.73	7,481,397	1,098,803	14.69	6,634,651	1,021,041	15.39

Value of imported wood material and duties paid thereon, etc.—Continued.

Articles.	1883.			1884.			1885.		
	Value.	Duty.	Rate.	Value.	Duty.	Rate.	Value.	Duty.	Rate.
Wood:									
Fire-wood.....free.	$397,391	.....	.....	$373,912	.....	.....	$338,806	.....	.....
Hop-poles.....do..	.....	.....	.....	40,399	.....	.....	18,780	.....	.....
Railroad ties.....do..	622,657	.....	.....	382,719	.....	.....	187,168	.....	.....
Cabinet wares, finished ..	282,636	$98,923	35.00	291,929	$102,175	$35.00	265,928	$93,075	$35.00
Laths, pickets, and palings	266,007	38,158	14.34	315,125	39,483	12.53	250,846	33,427	13.33
Shingles	281,831	36,741	13.04	215,454	30,157	14.00	158,043	24,414	15.45
Osier and willow baskets, etc	262,056	91,720	35.00	237,834	71,350	30.00	202,663	60,799	30.00
All manufactures of, n.e.s	905,582	314,954	34.78	692,969	238,242	34.38	628,967	216,564	34.43
Total wood manufactures	1,998,112	580,496	29.05	1,753,311	481,407	27.46	1,506,447	428,279	28.43
Total wood, unmanufactured.....free.	4,565,064	.....	.....	4,353,849	.....	.....	3,527,324	.....	.....
Total wood and manufactures, of dutiable	9,604,639	.....	.....	9,387,833	.....	.....	8,250,809	.....	.....
Total value of all wood imported	14,1 9,703	.....	.....	13,741,682	.....	.....	11,778,133	.....	.....

Articles.	1886.			1887.		
	Value.	Duty.	Rate.	Value.	Duty.	Rate.
Tanning materials:						
Hemlock bark .....free..	$236,198	.....	.....	$272,956	.....	.....
Other material, crude.....	8,845	.....	.....	19,134	.....	.....
Wood, unmanufactured.....free..	2,774,976	.....	.....	2,734,620	.....	.....
Paper pulp.....	280,056	$28,006	$10.00	497,273	$49,727	$10.00
Wood and manufactures of:						
Timber, logs, and spars, etc.....	2,221	366	16.48	1,025	202	19.71
Hubs, posts, etc.....	86,873	17,332	20.00	61,019	12,167	19.94
Total wood, etc.....	89,094	17,698	19.86	62,044	12,369	19.93
Boards, planks, deals, etc.....	5,639,813	917,394	16.27	5,825,320	930,653	15.97
Clapboards.....	59,390	5,889	9.92	58,953	6,362	10.79
Staves	269,961	26,996	10.00	304,031	30,403	10.00
Furniture, unfinished, osiers, etc.....	167,971	19,477	11.60	224,414	27,308	12.17
Total.....	6,137,135	969,756	15.80	6,412,718	994,726	15.51
Wood:						
Fire-wood.....free..	349,135	.....	.....	327,349	.....	.....
Hop-poles.....do...	12,511	.....	.....	3,278	.....	.....
Railroad ties.....do...	377,443	.....	.....	484,945	.....	.....
Cabinet wares, finished.....	306,066	107,123	35.00	376,788	131,876	35.00
Laths, pickets, and palings.....	260,074	35,300	13.57	273,984	35,191	12.84
Shingles.....	171,523	27,685	16.14	185,611	31,355	16.89
Osier and willow baskets, etc	238,380	71,514	30.00	312,179	93,654	30.00
All manufactures of, n. e. s	570,171	194,226	34.06	600,181	204,014	33.99
Total wood manufactures.....	1,546,214	435,848	28.19	1,748,743	496,090	28.37
Total wood, unmanufactured.....free..	3,514,065	.....	.....	3,550,192	.....	.....
Total wood and manufactures of..dutiable..	7,772,442	.....	.....	8,223,504	.....	.....
Total value of all wood imported	11,286,507	.....	.....	11,773,696	.....	.....

NOTE.—In the classification of articles in the above table, adopted from the Bureau of Statistics, some minor articles are not included. The total value of wood imports appears less, therefore, than in the preceding table.

omparative statement of imports and exports of wood and its manufactures and of forest products between Canada and the United States in the year 1887.

Articles.	Imports.		Exports.	
	Total.	From United States.	To United States.	Total.
Logs and round unmanufactured timber	$336,886	$335,179	$341,083	$346,638
Fire-wood	3,921	3,921	311,715	311,931
Lumber and timber (duty free)	524,131	520,862	570,610	624,167
Lumber and timber (dutiable)	96,025	95,616	7,630,431	18,574,956
Tan-bark	2,860	2,860	235,787	235,787
Tan-bark extract	10,744	10,529	58	136,077
Other forest products	96,614	94,990	290,675	392,257
Carriages	348,459	317,552	14,477	18,540
Musical instruments	472,025	379,745	14,205	207,339
Other manufactures of wood	1,082,214	846,484	401,851	573,212
Totals	2,973,879	2,607,438	9,790,892	21,430,904
Per cent		87.7	45.7	

Of the total export of raw material from Canada 46 per cent. goes to Great Britain and 45.7 per cent. the United States.

Of the exports from the different provinces the following proportions go to the United States: From ntario, 99.8 per cent.; from Quebec, 17.3 per cent.; from Nova Scotia, 22.9 per cent.; from New Brunsick, 16.8 per cent.; from British Columbia, none.

Specified exportations into the United States from Canada.

Articles.	Value.	Articles.	Value.	Articles.	Value.
Logs:		*c.* Lumber, etc. (free)—Continued.		*d.* Lumber, etc. (dutiable)—Continued.	
Hemlock	$17,447	Masts and spars	$6,416	Lath, paling, pickets	$301,536
Oak	7,755	Lath-wood	480	Planks, boards, joists	6,209,023
Pine	49,242	Bass-wood, butternut, hickory, unmanufactured	4,928	Scantling	50,895
Spruce	88,773	*d.* Lumber and timber (dutiable):		Staves and headings	273,519
All other	177,866	Battens	6,695	Shingles	136,905
Lumber and timber (free):		Pine deals	21,445	Other lumber	475,106
Railroad ties	335,274	Spruce and other deals	41,018	Box shooks	102,571
Stave bolts	121,263	Deal ends	561	Square timber	10,677
Shingle bolts	3,410				
Hop, hoop-poles, telegraph poles	92,303				
Knees and futtocks	7,016				

Specified importations into Canada from the United States.

Articles.	Total importation.	Value.	Articles.	Total importations.	Value.
Lumber and timber, planks and boards, sawn, not manufactured (all from United States):			*k.* Manufactures of wood—Continued:		
Box, cherry, chestnut, gum, hickory, white wood		$44,925	Caskets and coffins	$4,506	$4,506
Oak		63,552	Hubs, spokes, parts of wheels	7,737	7,737
Pitch pine		47,015	Moulding, plain	1,592	1,592
Redwood		38	Moulding, finished	28,887	28,341
Hickory		20,149	Shingles	8,091	8,091
Walnut		287,273	Show-cases	2,622	2,311
Manufactures of wood:			Wooden ware, tubs, pails, etc	33,081	32,882
Barrels	$172,234	172,234	Wood, manufactured, n.e.s	421,222	364,303
Clothes wringers	1,013	919	Picture frames	32,865	19,951
Fishing rods	5,842	3,932	Pipes	108,525	10,626
Furniture	222,030	185,854	Veneers	3,052	3,052

*Review of the timber export trade of the principal exporting countries.**

Countries.	1885.	1886.	1887.
	Cubic feet.	*Cubic feet.*	*Cubic feet.*
Sweden	119,588,040	113,805,285	121,966,020
Norway	67,600,500	64,812,000	65,455,500
Finland	46,246,860	39,480,725	42,095,625
Russia (imperfect)	148,691,400	146,352,340	149,609,955
Germany (official)	62,927,700	54,287,000	63,153,100
Italy (oak staves)	507,390	357,400	517,850
Canada (official)	159,658,880	172,910,890	168,028,850
United States (official)	127,372,930	122,173,650	114,074,370
Totals	732,593,700	714,179,280	744,901,270

*Amount and prices of hewn and sawn wood (exclusive of staves and furniture wood) imported into Great Britain, and proportion furnished by various countries.**

Year.	Amount.	Price per 100 cubic feet.	Approximate percentages.					
			Norway, Sweden.	Russia.	Canada.	Germany.	United States.	Other countries.
	Cubic feet.							
1881	276,757,300	$2.72	36	20	23	4	7	9
1882	309,758,350	2.54	36	24	21	5	6	8
1883	342,811,900	2.42	36	20	26	5	6	7
1884	299,803,750	2.26	37	22	20	5	7	9
1885	308,248,950	2.25	37	23	20	5	6	9
1886	268,059,960	2.11	38	23	21	3	7	8
1887	275,451,000	(?)	38.7	23.7	19	3.6	7	8
Average	294,421,600	2.38	36.8	22.3	21.5	4.4	6.7	8.3

*These two tables have been compiled partly from reports given by the Timber Trade Journal of London, England, and partly from other sources.

MILL CAPACITY.

It would be almost impossible to ascertain the amount of lumber produced each year in the States. The possibilities of lumber production, however, may be estimated from the following table, which exhibits the sawing capacity of the mills that have been reported through the directory of the Northwestern Lumberman for 1887. However complete this directory may have been made, it must have fallen short of the actual number of mills scattered through the country. It may therefore not be unreasonable to assume that the highest capacity is nearest the truth as regards actual production. The reports were given for seven classes of mills with as many ranges of capacity. The lowest and highest reported capacities have been aggregated for each State in the following table, from which it would appear that the mills in the country, as many as reported, would be capable, if driven to their full capacity, of producing not less than 200,000,000 feet B. M. of lumber daily; or to express this condition with relation to supplies, to keep our present mill-capacity alone fully occupied the annual growth of not less than 500,000,000 acres of well-stocked forest would be required, while a forest area capable of producing such amounts is not to be found in the United States.

These rough figures again serve to call our attention forcibly to the fact that we have entered upon the road to exhaustion of lumber supplies; that we are squandering our capital instead of living on the interest which our forest area, if properly managed, might yield for-

ver; that the need is at hand for a wiser policy which will dictate greater economy, fuller utilization, better protection, and recuperation of our forest lands.

[S. indicates saw-mills and Sh. shingle-mills.]

States.	Mill.	Daily capacity.		States.	Mill.	Daily capacity.	
		Lowest.	Highest.			Lowest.	Highest.
		Feet.	*Feet.*			*Feet.*	*Feet.*
Maine	S	1,630,000	3,080,000	Wisconsin	S	10,260,000	17,830,000
Do	Sh	1,181,000	1,830,000	Do	Sh	2,000,000	3,525,000
New Hampshire	S	1,001,000	1,885,000	Minnesota	S	5,132,000	7,780,000
Do	Sh	96,000	180,000	Do	Sh	799,000	1,350,000
Massachusetts	S	212,000	370,000	Ohio	S	5,048,000	9,660,000
Do	Sh	17,000	30,000	Do	Sh	69,000	130,000
Connecticut	S	17,000	30,000	Indiana	S	3,775,000	7,430,000
New York	S	4,007,000	7,250,000	Do	Sh	108,000	200,000
Do	Sh	1,086,000	1,760,000	Illinois	S	1,659,000	2,805,000
Pennsylvania	S	10,1 9,000	1,865,000	West Virginia	S	795,000	1,545,000
Do	Sh	1,081,000	1,995,000	Do	Sh	12,000	20,000
New Jersey	S	97,000	190,000	Kentucky	S	2,036,000	3,905,000
Do	Sh	5,000	10,000	Do	Sh	153,000	270,000
Delaware	S	66,000	120,000	Tennessee	S	3,260,000	6,310,000
Maryland	S	452,000	840,000	Do	Sh	126,000	240,000
Do	Sh	5,000	10,000	Arkansas	S	3,066,000	5,735,000
Virginia	S	3,260,000	6,310,000	Do	Sh	583,000	1,000,000
Do	Sh	126,000	240,000	Missouri	S	1,523,000	2,855,000
North Carolina	S	859,000	1,690,000	Do	Sh	85,000	170,000
Do	Sh	99,000	170,000	Iowa	S	2,050,000	2,945,000
South Carolina	S	367,000	715,000	Do	Sh	550,000	825,000
Do	Sh	30,000	60,000	Dakota	S	5,000	10,000
Georgia	S	1,808,000	3,535,000	Kansas	S	65,000	130,000
Do	Sh	164,000	300,000	Montana	S	199,000	365,000
Florida	S	1,670,000	3,055,000	Do	Sh	22,000	40,000
Do	Sh	444,000	780,000	Idaho	S	51,000	90,000
Alabama	S	2,413,000	4,525,000	Do	Sh	12,000	20,000
Do	Sh	257,000	490,000	Nevada	S	87,000	170,000
Mississippi	S	1,241,000	2,285,000	Do	Sh	25,000	50,000
Do	Sh	55,000	110,000	Utah	S	79,000	155,000
Louisiana	S	1,057,000	1,985,000	Do	Sh	35,000	70,000
Do	Sh	412,000	670,000	California	S	524,000	915,000
Texas	S	2,421,000	4,555,000	Oregon	S	1,346,000	2,380,000
Do	Sh	1,000,000	1,600,000	Do	Sh	105,000	210,000
Michigan	S	23,789,000	40,370,000	Washington	S	2,470,000	3,885,000
Do	Sh	12,742,000	20,045,000	Do	Sh	426,000	770,000

Approximate total daily mill capacity of the United States:

Lowest	feet B. M.	123,936,000
Highest	do	200,815,000

TARIFF ON LUMBER.

The consideration of the tariff on lumber, so far as it bears upon the forestry interests of the country and the development of dependent industries, necessarily belongs in the range of investigations devolving upon the Forestry Division.

The questions to be asked in the consideration of this subject might be formulated as follows: What effect has the duty had on the amount of importations of lumber and on the development of our forest resources? Will the removal of the present duty increase the importation of lumber? Will such importation make our natural wood supplies last longer, and is it desirable to extend the duration of these supplies? What local injury, if any, would result from the free importation of lumber to our manufactures? Would any such presumed local injury be counterbalanced by advantages to the community at large?

For a thorough discussion of these questions upon positive facts the data at hand are deficient, and the space assigned to this report

allows us only to give the following notes and conclusions for what they are worth.

The position of lumber in regard to the tariff question differs from that of all other material in three essential points: First, there is only one country with which we are practically in competition, namely Canada. We allow the raw material, unmanufactured wood, to come in free, but the Canadian Government imposes a retaliatory export duty on the unmanufactured article (logs), so that practically all wood coming from Canada, except fire-wood, hop-poles, and railroad ties, pays a duty. Secondly, the bulkiness of the material places decided limitations upon the range in which competition is possible. Lastly, there is in both countries a limited supply of available material, which fact must tend to keep prices advancing in both countries, especially for the main staple of the present lumber market, White Pine, and its substitutes, Spruce and Hemlock.

The factor of transportation, it should be understood, makes the tariff question on lumber to some extent a "local" one, that is to say, the direct competition is confined to the localities into which it will pay to transport the bulky material, and the question is a different one according as we discuss it for the New England States, the Middle States, the Southern States, or the Northern Pacific Territories. Even before the tariff was laid not more than 25 per cent. of the cut in the eastern provinces of Canada was sent into the United States, while the entire product of Ontario found its way into our country, and the timber of British Columbia was not yet developed.

From an inspection of the import statistics it appears that the import duty laid upon manufactured lumber in 1872 had the effect at first of decreasing importations from Canada by from 50 to 60 per cent. in 1876 or 1877, when again an upward tendency of imports begun. Comparing the importations of the last three years with those of the preceeding three, however, there is noticeable again a decline in all classes of forest products from the amounts to which the same had gradually increased up to 1884, when the importation of manufactured lumber reached nearly the same amount that was imported in 1872.

For the decrease in unmanufactured wood the Canadian export duty of $2 on logs may serve as explanation, but other causes must have worked to effect the reduction in manufactured lumber in the face of a decided enhancement of value of the pine product. Difficulty of access and increased distance from the market is probably the explanation.

This decline in importations appears as follows:

Importation.	1882–'84.	1885–'87.	Decline.
			Per cent.
Manufactured lumber	$21,510,765	$19,184,504	10.8
Wood, unmanufactured	10,404,474	8,502,165	18.3
Manufactures of wood	5,053,040	4,801,404	15
Fire-wood, hop-poles, railroad ties (no duty)	3,008,945	2,099,415	32.5

That the existence of the tariff would have had any other effect upon our forest resources than to hasten their depletion could not very well be expected. It is also reasonably certain that the larger margin created by the import duty and the consequent stimulated

home competition have induced a more wasteful utilization of the standing supplies, while competition of foreign raw material might have necessitated a closer working or delayed the opening of distant forest areas.

At the present stage of development, however, it seems, so far as the saving of standing supplies is concerned, there need be no fear nor hope from foreign competition, for "the quantity of standing pine in the United States and Canada is reduced to a condition of absolute control; it is held in strong hands on both sides and will not be lightly frittered away." The stumpage price, which has lately advanced as never before, will necessitate the upholding of present values for manufactured lumber, and an advance of prices is as certain as a decrease of supplies.

The discussions of the tariff question in the "lumberman's" papers is naturally tinged by diverse personal interests, according as the manufacturer owns stumpage or relies upon supplied material. There are a number of American lumbermen who have invested millions of dollars and hold large timber-limits in Canada, and their interest would lead them to desire the removal of the incumbrance of $2, which the Canadian Government places on the unmanufactured, and the home Government on the manufactured article. The establishments on this side of the line do not wish to lose the margin of $2, although, as a lumber dealer expressed himself, "they can well afford it, for they control supplies, production, and price."

It is argued that whatever may be the temporary effects of a local or personal character that might result from the abolition of the tariff, such effects would not be immediately felt; they would not be great, and only short-lived. The range in which Canadian lumber, which has never been kept out by the duty, can compete with our own will be extended by so much as the amount of the present duty, if removed, would pay for extended transportation; meanwhile the Canadian stumpage will increase in value, and the distance from which Canadian supplies must be brought will increase so as to offset any temporary advantage.

An unbiased weighing of the arguments advanced on both sides leads to the conclusion that the removal of the tariff on lumber would have no appreciable effect upon the price to the consumer, nor be detrimental to the lumberman's or saw-mill business, nor in the least affect the laboring man; but at the same time no appreciable benefit towards preservation of forests and forest supplies need be expected at this date from such removal. Possibly positive local advantages may be gained, if by such competition local manufactures were encouraged and the shipping of raw material made less profitable.

SEED AND SEEDLING DISTRIBUTION.

One of the most embarrassing duties of this Division has been the requirement, expressed in the appropriation, to "collect and distribute valuable economic tree seeds and plants."

There is no doubt that the supply of plant material to the settler on the treeless plain could be made an effective incentive to forest planting, but it would have to be done on a different scale from that which has been practicable so far. Not that the cost of the material is of so much moment to him in many cases, but the inconvenience of procuring it and the uncertainty of obtaining proper mate-

rial has been felt by the planter in the far Western settlements as a drawback. This mode of encouraging forest growing has been productive of the best results elsewhere, notably in Australia.

NOTE.—From the annual report for 1886-'87 of the Conservator of the Woods and Forests Department of South Australia, J. Ednie Brown, we take the following notes, of value for our own consideration in connection with tree-planting on the Western plains, which climatically somewhat compare with that colony:

"Of late years the seasons, as regards the amount of rain which fell, have been unusually dry and trying; but the one with which we are now dealing was the driest and least favorable. Notwithstanding the apparent unfavorableness of the season, the past year's planting operations have been the most extensive, most varied, and most successful which the Department has enjoyed. Much valuable experience has therefore been gained by the results of the past year, particularly as it shows that with a fair amount of well-timed rains it is possible to plant trees with more than ordinary success well into the summer or hot months."

The Government forest reserves contain now an area of 181,984 acres. The area of inclosed lands for planting amounts to 7,721 acres. The Government planted during the season 628,457 seedlings, mainly of Eucalyptus and Pines, among which our California *Pinus insignis* (Monterey Pine) takes a prominent part. Of this planting 80 per cent. have lived, which, says the report, "considering the variety of situations dealt with, the deficient rain-fall, together with the unfavorable weather, as a whole is highly satisfactory."

For the encouragement of tree-planting in the colony, 213,061 plants were distributed to 766 persons. In order that the free distribution of trees might be made as public as possible, a notice in regard to it was published in the Government Gazette for several months. Up to date, $9,500 have been spent by the Government in raising trees for free distribution, and from reports received there are 565,000 trees alive, costing the Government 1½ cents each.

"Of all the operations of the department, I consider there is none more important than that of this free distribution of trees."

Even Prussia, with a model state forestry and a highly developed private forestry, found it desirable to distribute from the Government nurseries during the last year 38,000,000 seedlings free of charge and 24,000 pounds of seed at nominal cost. The funds provided for this Division during the last year have allowed the purchase of only about 300 pounds of seed and a contract for about 50,000 seedlings. Although no publicity was given to this part of the work, applications have been quite numerous and the stock on hand was soon exhausted.* In addition several thousand tree-willow cuttings, grown by the Superintendent of Grounds, were distributed. The kinds mainly selected for distribution are enumerated further on in this report, with such notes as will assist in a rational cultivation of the same. Since forest planting means planting on large areas and requires a large number of plants to the acre, it is at once apparent that under present conditions the Government can not supply the plants for many acres and to many applicants. The object, then, of Government distribution of plant material can only be to encourage the practice of tree-planting in a small way and to induce the planting for trial of such kinds of trees as would not otherwise attract the tree-planter, either because success is uncertain, or plant material too costly or difficult to obtain, or results too distant to induce him to incur the expense for the material. The Division has therefore directed its attention mainly to the economically valuable conifers, because they are or appear to be more difficult to handle by the inexperienced planter and consequently do not attract him sufficiently; yet they are among the most useful and desirable forest trees, espe-

*By an oversight in the disposal of these seeds, it has occurred that a number of applications were filled without the usual control and direction of the Forestry Division, and in consequence it is possible that the most suitable kinds may not in every case have been sent to the applicants.

cially in mixture with deciduous-leaved trees. Another consideration which made the purchase of conifer seeds more desirable is, that most of these will retain their germinating power longer than seeds of most deciduous-leaved trees and can therefore be kept without as much danger of loss.

In the absence of a proper system of obtaining applications at the right season this caution is very unnecessary.

A tentative plan has been instituted in supplying seedlings directly from the nursery, which has so far worked entirely satisfactorily. A contract has been made with a nurseryman to supply seedlings to a certain amount on requisitions made from time to time by the Department. The orders are filled directly from the nursery, in the usual manner of nursery business; a letter of advice with a form for acknowledgment of receipt goes to the applicant, which, together with the acknowledgment of the order by the nurseryman, establishes a perfect system of accounting. This plan, so far, could only be inaugurated with one nurseryman on a small scale; but should an extension of this manner of supplying plant material be made possible, a nursery in each of the tree-planting States should be so engaged, in order to divide the business and to obtain the plant material as near as possible to the locality where it is to be used, which is desirable.

One nurseryman doing a large business, to whom the contract was offered but who could not take it, expresses himself on this plan as follows:

> Whilst I am aware that most nurserymen might be opposed to this new system of free distribution, I am sure it will be a good thing for the country; it will awaken a greater interest in forest-tree planting than could have been done by any other method. I am sure this enterprise can not fail in bringing about the greatest revival in tree-planting ever known in any country.

To produce such a result, however, it would be necessary to provide more adequate means than can at present be devoted to this part of the duties for which the Division is established.

While the work of the Division hitherto has been mostly of the nature of compilation from other sources and from such statistical information as could be obtained from private correspondents, without pay, without organization, and often without proper knowledge, the time seems to have arrived when direct original investigations should be undertaken with a view of furthering forestry practice.

The field of such investigations is broad and in this country almost entirely uncultivated, and to insure the best results it will be well to go to work systematically to define the directions in which the investigations are to proceed, to find the limitations and the points of prime importance to be reached, and to determine the methods by which such information is to be arrived at; in fact, to devise a

Systematic plan of forestry work.

Such a plan may be formulated under the following divisions, which define certain lines of work, not so rigidly separate, however, but that one line of inquiry may overlap and supplement another, nor laying claim to such logical co-ordination or completeness as to raise the plan to the rank of a scientifically correct system. Yet this plan may well serve as a guide for the work of the Forestry Division and do temporary service in the furtherance of our as yet undeveloped forestry knowledge.

A.—The **scientific basis** of forest management must be built up by investigations in the following directions:

I.—Forest biology.

The thorough knowledge of the life history of our timber trees, represented by different species, so far as this knowledge bears upon the practice of forestry, as well as the life history of the forest as a whole, in which the species form parts of a community, is of prime importance.

We are but imperfectly acquainted with the conditions under which the different trees of our forest flora or those which are recommended for forest planting develop to best advantage; we are unacquainted with the progress of their development; above all, we are lacking the exact knowledge of the rate of growth of different timbers at different ages under different conditions, upon which alone the financial questions of forestry can be discussed. Whatever notes exist on this subject lack for the most part sufficient data of conditions to allow generalization upon the same. We have hardly begun to understand that a forest is not merely a collection of trees, but an organic whole and must be treated as such. As the development of man must be studied by itself as well as in his relation to his neighbors, to the community at large, so our study of the forest must include both a consideration of the individual tree by itself and in its aggregation with others.

This branch of investigation may be subdivided as follows:

(1) *Timber and forest physiology*, or study of the life history and individual development of the various species, by themselves and in aggregate life.

(*a*) *Native species.*—We would begin with those most important in our natural forests, including those which have made a claim for recognition in our artificial forest planting of the West. The nature of these studies is exhibited in the schedule given in my last year's report, on page 187. This work has been begun, and there will be ready soon for publication, if opportunity is given, monographs on the White Pine, Red Pine, Pitch Pine, the Long-leaved, Short-leaved, Loblolly Pine, the Hemlock, and the two northern Firs, also the Bald Cypress, these being the most important conifers of the Eastern States.

(*b*) *Exotic species.*—For the present it will suffice to record the life history of those which have been most commonly planted in this country as it has been studied abroad, in order to make a more rational use of the same possible for our forest planters. Such short biographies of the most important European species, serving as a guide for the determination of their requirements and their adaptability for use in this country, have been prepared and are awaiting publication. It will, however, become the duty of the forest botanist also to search the globe for such other species as are likely to promise successful growth in this country, keeping especially in view the requirements of the arid regions.

(2) *Forest geography*, or study of forest floras in their make-up and their distribution. This knowledge, if coupled with a study of the climatic conditions prevalent in the different sections and with a study of the climatic factors upon which each species seems specially to depend, will enable us to judge upon a more rational basis of the chances of artificial extension in the distribution of different species. A knowledge of the local forest flora, besides, will be a great help to the student or practitioner of forestry in making his own ob-

servations. It will be the office of the forest botanist to classify, describe minutely as to preference of site and other conditions of growth, the timber trees and other woody plants of the various sectional forest floras. The work on the forest flora of the Rocky Mountains, referred to above, with an artificial key by which the layman may readily distinguish the various species, is the first undertaken in this direction by the Division.

(3) *Study of forest weeds.*—The knowledge of the smaller flora is of importance to the forester as far as it serves to indicate soil conditions and forest conditions. This branch of forestry science is very little developed, even in Europe and deserves more attention in the future, as it furnishes no small aid in forest management.

(4) *Phenological and climatic studies* (so far as they relate to forestry practice).—The nature and value of these studies have been briefly sketched in my last year's report (p. 176) and are referred to again further on in this report (p. 68). In connection with these studies it will become necessary to find new methods of climatography. The present notations of meteorological conditions are very unsatisfactory and undeveloped, and of but little use for determining their result and influence upon vegetation.

The usual and popular method of noting climatic conditions of a locality, by giving the monthly or even annual means, does not, it is evident, give a fair idea of the actual conditions which are felt by animal and vegetable life. These can be judged only by a knowledge of extremes, by denoting their respective durations, and by such a combination of the simultaneous records of the different factors that make up a climate as will readily convey an idea of the total effect. In the absence of satisfactory climatic notations phænological observations may serve as substitutes.

An attempt to obtain satisfactory results in this direction, from a co-operation of the agricultural colleges and other private observers, has found but little encouragement, probably because the value of such co-operation had not been sufficiently understood. The results of the observations, so far as made available, have been collated and are presented in another part of this report.

II.—Timber physics.

While forest biology contemplates the forest and its components in their living conditions, we may group under the name of timber physics the results of all investigations into the character of the dead material of forest production. The properties upon which the use of wood, its technology, is based, should be well known to the forest manager if he wishes to produce a crop of given quality useful for definite purposes. Our ignorance in this direction has been most fruitful in fostering a wasteful use of our natural forests, and the same ignorance misleads even the forest planter of to-day in choosing the timber he plants and the locality to which he adapts it.

How the Black Walnut has been sacrificed for fence material, how the valuable Chestnut Oak has rotted in the forest unused, how the Hemlock has been despised and passed by when it might have been successfully used to lengthen the duration of White Pine supplies, how timbers are used in unnecessarily large sizes and applied to uses to which they are not adapted, while other timbers are neglected for uses for which they are adapted—all these unfortunate

misapplications are or have been due to lack of knowledge of the technological properties of our timbers. Every day almost brings to light a new use for this or that timber, every now and then lumber papers are weighing the serviceability of this or that wood. Instead of proceeding on a sure and scientific basis in recommending the application of any wood to a particular use, opinions pro and con are brought to bear and the proper development and use of our resources is thereby retarded. Yesterday it was Redwood that needed commendation in the market, to-day it is Cypress that must be praised in order to receive due appreciation.

Our timbers have never been fairly tested, or if they have their qualities are not duly appreciated. Many kinds have their use and value still hardly recognized; woods of exceptional value for manufacturing purposes are consumed for fuel; valuable and scarce varieties are used for coarse work, while cheaper and more abundant sorts are available.

Still less knowledge exists in regard to the conditions of growth which influence the quality of woods. Crude "experience" has been our guide, and "crude" has remained our knowledge. Thus we hear of "second-growth" ash, hickory, etc., a very vague term indeed, as furnishing the only acceptable wood for many of the purposes to which it is put; and of the comparative uselessness of "second-growth" pine; while the difference lies simply in the conditions under which the "second growth" has grown, in the one case increased light influence, or in its age in the other case. The differences made in trade as to localities where the timber is grown, as also the differences made or not made as to qualities of timber used interchangeably, are often without any proper foundation.

Naturally, too, in recommending trees for afforestation, this point of consideration has been almost entirely lost sight of. If planted for a crop to furnish wood of certain quality, it is quite essential to consider the soil conditions and climatic influences under which the crop is grown.

The forest planter or lumberer, as well as the wood consumer or manufacturer, will be benefited by a definite knowledge of the qualities of timber and of the factors which influence the same.

The Census Report of 1880, in Volume IX, contains a very large number of tests made on some 300 to 400 species of our forest flora for the purpose of ascertaining their qualities. These tests, while the most valuable work of this class and highly useful in determining the general technological character of our timber trees, are yet for practical purposes and for special comparison lacking in detail, because not sufficient data as to the character of the samples from which they were taken and the conditions of growth accompany the tables.

A plan for the thorough examination of the most important species is maturing in the Division, and as a preliminary introduction to careful and extended experiments on special timbers a bulletin giving an account of the general knowledge so far attained in this field and detailing the methods of experiment in use is preparing.

The most essential qualities for practical purposes to be determined are the specific weight when green and when dry; the shrinkage of the green wood and the capacity of the dry wood for water; the elasticity and strength, and the resistance against crushing, tearing, and bending forces. A series of practical experiments to test durability, ease of working, and adaptability to various uses are also contemplated.

A detailed investigation of the anatomical structure, which has so decided an influence on the specific weight, is expected to yield data upon which to base a ready estimate of quality. The chemical composition, hardness, cleavability, and minor qualities, such as the grain, color, susceptibility to polish, etc., also the faults or the effects of diseases of timber, will form an object of these investigations.

Lastly, this investigation will have to be so conducted as to determine the factors which produce difference of quality in the individuals of the same species and of different species. As such factors are to be considered the width and nature of the annual rings, the age, the part of the tree from which the wood has been taken, the various conditions of the site in which the tree has grown, the treatment which the wood has received after felling.

We may touch here only briefly upon the influence of the annual ring, and that especially for the purpose of asserting the existence of the latter as such in all timber grown in the temperate zone, and to call attention to the difference of structure of the annual ring in different groups of timbers, as from the appearance of the annual ring alone the quality of the timber may be judged to some extent. In this the following three factors are to be taken into consideration; the absolute width of the rings, the regularity in their width from year to year, and the proportion of spring wood to autumn wood. The spring wood is characterized by less substantial elements (vessels of thin-walled cells in greater abundance), while the autumn wood is formed by thicker-walled cells, which therefore appear of darker color. In the wood of conifers, and in that of deciduous-leaved woods in which the vessels (appearing as pores on a transverse cut) are most frequent in the spring wood, the annual ring is usually very distinctly visible; while those woods which, like birch, linden, maple, etc., have the pores (vessels) evenly distributed throughout the annual ring growth, the distinction is not so marked. Sometimes the gradual change in appearance of the annual ring from spring to autumn wood, which is due to the difference of its component elements, is interrupted in such a manner that seemingly a more or less pronounced layer of autumn wood can be recognized, which again gradually changes to spring or summer wood and then finishes with the regular autumn wood. This irregularity may occur even more than once in the same ring. Such double or counterfeit rings, which can be distinguished from the true annual rings by a practiced eye with the aid of a magnifying glass, have led to the notion that the annual rings are not a true indication of age. The cause of such irregularity may be sought in some temporary interruption of the vigorous functions of the tree, induced by defoliation, for instance, or by extreme climatic conditions, such as sudden changes of temperature, cold days followed by sudden warm weather, or droughts followed by rain.

The doubt thrown by some upon this faithful record of annual growth—which all scientists recognize in the ring, and which no one conversant with the causes of apparent discrepancies has found reason to cast aside—has been lately a matter of public discussion; and as the practical importance of the controversy justifies its fuller consideration here, the following letter written to the Nation of January 12, 1888, is inserted:

RING GROWTH IN TREES.

The discussion on the age of the Sequoias has brought up the question of the truthful record of age as indicated by so-called annual rings. While the former question

is one of curiosity, the latter is one of decidedly practical importance, as its answer may affect the property rights of any citizen who is unfortonate enough to have to rely for the boundary lines of his land claims on the blazes with which a backwoods surveyor has marked the course of the survey lines. For, as is well known, the courts have had often to decide the priority of a survey and therefore title to land solely upon the evidence of a surveyor's overgrown mark made a certain definite number of years ago, the "annual ring" deciding the time of survey.

It is then of great importance to the community that the subject should not be lightly or, without very sufficient basis, authoritatively discussed. It is desirable that without overwhelming evidence the belief in the accepted theory should not be disturbed. This accepted theory claims that wherever the seasons are determined by decided changes of temperature and consequent rest, followed by re-awakened vegetation, such changes are marked by the formation of annual rings; that is to say, the cell elements constituting the wood formed in the first few weeks of awakened activity in the spring differ in form and appearance from those formed later in the season. That the same effect in a smaller degree may be expected from other alternating checks and resuscitation of vegetable activity is but natural; such climatic disturbances as droughts followed by rainy seasons, or even the defoliation from some cause early in the season with consequent recovery of foliage, will produce a similar appearance in the arrangement of cell elements to that which characterizes the annual ring.

The counting of an excessive number of rings during a given number of years which is reported from the fitful climate of Nebraska is, therefore, not surprising. But it also reveals probably a prejudice against the accepted theory or a love for new discoveries and a lack of sharp observation on the part of the reporter; or else the less pronounced appearance of the intermediary rings and their characteristic discontinuity if followed round the section would have been noticed. Having myself had occasion, for purposes of forest scientific investigations, to count the rings of many hundred sections of trees, I may be presumed to know something of the difficulty sometimes experienced in determining the annual as distinct from secondary rings. Yet, so far, no evidence has come before me which would shake my belief in the accepted theory, upon which the whole scientific system of German forestry is practically based.

To allay all doubts, the Forestry Division of the Department of Agriculture is collecting material upon which to decide this very important question, and seeks the co-operation of all those who are in position to forward sections of trees with well authenticated record. It may be of interest also to state that as trees of positively known age are probably rarely cut, and as the height at which they are cut may leave from two to five years' growth untouched and thus lead to discrepancies, other records must also be made use of. For instance, a short time ago I read from a section of a hickory tree sent in its life history, which was afterwards confirmed by inquiry: the rings revealing that nineteen years before it was cut, having grown in the dense shade of a forest, an overpowering neighbor had been removed, but in three years' time another neighbor had taken possession of the empty space above and set back the hickory. The season of 1879 was marked as unfavorable, and in 1875 a sudden change of conditions, found to be the clearing of a field by which the tree was placed in the full enjoyment of light, was unmistakably indicated.

I hope that these statements will prove of sufficient interest to be presented to your readers and may engage their co-operation in supplying evidence for or against the theory of annual rings.—B. E. F.

The absolute breadth of the annual ring depends on the length of the period of vegetation; also, the deeper and richer the soil and the greater the influence of light upon the tree the more of formative material can be produced by the tree and the broader will be the annual ring.

In coniferous wood the width of the autumn wood, with cells of thickened walls, is almost the same in wide as in narrow annual rings, while the more porous spring wood changes in width with the general width of the annual ring. Consequently, on account of the more frequent occurrence of heavy autumn wood in a given volume of narrow-ringed wood than in that of wider-ringed wood, such wood is heavier, and, as a rule, narrow-ringed conifer wood is the better. And with certain limitations the opposite is true for broad-leaved trees which have their vessels chiefly in the spring wood, while those

with the vessels distributed through the ring are less influenced in their weight and quality by the width of the annual ring. Slow-grown conifers and quickly-grown hard woods furnish, therefore, as a rule, the best quality.

Besides the temperature of the atmosphere and the moisture conditions of the soil, it is the amount of light and consequent development of foliage which is perhaps the most powerful factor in wood formations, other considerations not being unfavorable. In the proper use of this factor mainly has the forester the means of regulating the slower or quicker development, and consequently the quality of his crop.

III.—Soil physics and soil chemistry.

These branches of knowledge are as intimately related to forestry as to agriculture, only that perhaps the physical properties of the soil are of more moment in forestry than in agriculture, and in practice the methods of cultivation must therefore differ. The elements which determine mechanical conditions of the soil—its looseness, depth, granulation, and consequent capacity for moisture—seem to be more important for forest growth than the chemical constituents, although we shall not be justified in omitting such chemical investigations into the dependence of quantitative and qualitative wood formation on certain minor constituents as would teach us the use of fertilizers in the growing of seedlings at least, or as might influence our choice of species for certain soils in mixtures or in a change of crop. As it is certain that with the development of the country forest-growing must be relegated to the agriculturally useless soils, the study of the conditions which allow the fullest utilization of these poorer soils for wood growth must become an important one.

If success in forest planting depends on good, healthy plant material; if weight is a good criterion for the determination of the value of seedlings; and if, as has been shown by experiment, one-year-old spruce grown on rich, well-manured soil furnishes double and two-year-old four times the weight of those grown in poor or unmanured soil, it is of importance to inquire whether the accepted notion "that all manure is hurtful in growing conifers" has a foundation in fact or not.

The physical improvement of soils by other means than manures, which latter can hardly become practicable in general forest growing, must be based upon a thorough knowledge of soils and their properties. The following examples may serve to illustrate the value of such investigations. Among the first objects for which such studies form the basis would be the needs in afforesting, for instance, the sterile limestone soils and shifting sands. In the first case the main work must lie in re-establishing or increasing soil moisture. This may, under certain circumstances, be accomplished by ditching so as to gather the rains and force them to filter through the soil rather than run off, and by covering the soil with any kind of undergrowth that can be made to grow, so as to prevent evaporation. In the second case the mechanical binding of the sand with brush, turf, or wicker-work may be necessary before even the moisture conditions can be improved by an addition of loam or muck. In planting Austrian, Scotch, or Maritime Pine, or perhaps our Douglas Fir, which seems quite capable of thriving under these unfavorable conditions of soil, a method has proved itself quite successful which at first sight does not seem rational. A thin puddle is made of two parts water and one part loamy forest soil or mold. In planting, a conical hole

is made to receive the plant, and while holding the plant in the hole the puddle is poured into it with a cup. The puddle must be stiff enough to hold the plant at a proper height, yet not too thick, because in such case it would not fill the bottom of the hole, but would adhere to the sides, and thus the tips of the roots would have no covering and would die off. To be sure, in hot weather the upper loamy layer dries out quickly and hardens, but this layer, not being hygroscopic, prevents the drying out of the lower strata, which is the important point to secure in the quickly drying sand. (The cost of this method of planting is about double that of ordinary planting in holes.)

B.—The **economic basis** of forestry is formed by consideration of the results of the following investigations:

I.—Statistics.

Forest statistics attempt a presentation of the present condition of forest property, forest management, and wood-working industries. This presentation must always keep in view and be connected with the progress of other industries which make up the working of a civilized community and not lose sight of the interrelation existing between all. It should not merely gather the stones, but also build them into a harmonious structure.

Forest statistics are among the most difficult to obtain, partly because of an absence of accurate observers or an unwillingness to give desired information, partly on account of the difficulty of devising standards of description. The attempt made by the Division to obtain such information in regard to the forest conditions of the lumbering States by the aid of the teachers of public schools has proved an absolute failure, only few satisfactory returns being received. A thorough organization of special observers and personal inspection by competent investigators alone will yield useful results.

In the absence of means to employ such men the Division has not undertaken any statistical work, except to canvass the forest conditions of Tennessee, the State from which one of the "forestry agents" was appointed.

The directions in which forest statistics are to be gathered may be grouped as follows:

(1) *Forest areas.*—Not only is it desirable to know the total forest area in relation to the number of inhabitants to total land area, to different agricultural crop areas, but in order to enable us to judge of the meaning of such areas, their location in relation to the configuration of the soil (mountain, hill, plateau, interior, sea-coast), in relation to watersheds and to trade centers, as well as their composition, condition, state of development, and possible yield ought to be known. Their occupancy of agricultural or non-agricultural soil is of interest, as also their proprietorship. Fire statistics and statistics of production belong also under this head.

(2) *Forest products.*—Statistics of the wood consumption by the various wood-using industries will furnish data upon which the demand on the forest areas can be calculated—mining, railroad building, lumbering, and saw-milling, furniture, large and small woodenware manufactures, charcoal manufacture, paper pulp, matches, tanneries, etc.

(3) Full statistics of the *by-products*, naval stores, etc., add to the conception of the value of forest growth.

(4) Statistics of *prices and trade*, of general development influencing the working of forests; statistics of substitutes for wood; also

of the development of irrigation systems as dependent upon regularity of water-flow influenced by forest cover; also of the history of forestry development, become desirable when a rational harmonious development of forestry and its numerous dependencies is to be fostered.

II.—Technology.

Technology of woods, or the adaptation of wood and other forest products to various industrial arts, requires special consideration, based upon the knowledge gained by the investigations into timber physics outlined before (A, II). The needs of wood-using industries from a technical point of view, their requirements of material, their dependence upon forest products, and the conditions and requirements in these products, are objects of this line of investigation, and these results will also affect the forest grower, at least in the manner of utilizing, handling, and disposing of his products in the most profitable manner. We may classify these investigations under the names of the various industries concerned, and as by their enumeration the wide scope in the application of forest products is made apparent, such classification is here given. The notes added are meant to serve the same purpose and to show how even the most insignificant use of wood may form a considerable item in the total of economies depending on the forest.

A. Industries using timber (sizeable wood) or manufactured lumber and shaped wood principally.

Carpentry, use of wood in structures:

(1) Construction above ground (high building): House building and other civil architecture.

(2) Construction below or on the ground (low building), comprising railroad building, mine timbering, and other subterranean use of wood, as piling, water and drain piping, military architecture.

(3) Construction wholly or partly in water, including ship and boat building and other naval architecture, river improvements, canal building, bridge or trestle building, piling, scaffolding, etc.

Joinery, cabinet-making, and wood-shaping industries:

(4) House-finishing and decorative wood-work: Sash, doors, blinds, window frames, moldings, looking-glass and picture frame manufacture.

(5) Car building.

(6) Carriage and wagon manufacture.

(7) Furniture manufacture, with all its adjuncts, as veneering, carving, turnery, and bent work.

(8) Manufacture of musical instruments, requiring quite special consideration in regard to the qualities of the wood.

(9) Box manufacture, as packing boxes, coffins, cigar-boxes.

(10) Machine building: Agricultural implements, tool stock, handles, mill-work, instruments.

(11) Small woodenware and articles of domestic economy.

Industries using mainly riven and shaved wood (or depending on the cleavability of the material):

(12) Cooperage: Pails, tubs, kegs, barrels, casks, tanks, shooks, and hoops.

(13) Shingle manufacture (now largely done by sawing).

(14) Basket and box making, and manufacture of measures.

(15) Minor small uses: Matches, tooth-picks, skewers, tree-nails, shoe-pegs, pencils, excelsior, etc.

B. Industries using wood directly from the forest, unshaped, or at most without special shaping.

(1) Fire-wood for home and various industries, including charcoal manufacture and the industries dependent thereon.

(2) Paper pulp and cellulose manufacture.

(3) Utilization of derivative materials and chemical by-products, as wood alcohol, wood acids, gas, tar, pitch, pearlashes.

(4) Use of wood in the shape of posts, poles, piles, stakes, sticks, fence material, paving blocks, etc.

C. UTILIZATION OF FOREST BY-PRODUCTS.

(1) Turpentine orcharding.
(2) Tanning materials, use of bark.
(3) Maple-sugar industry and other utilization of sap.
(4) Use of fruits, leaves, etc.

Under this division should also be considered the progress in methods of lumbering, the manner of preparing the raw material for market, the improvement in tools and machinery used in all lumber manufacture. The economist will also inquire into the utilization of waste products, which unfortunately are so enormous under our present methods, and will investigate the methods of increasing the durability of wood material.

The relation of the railroad industry to forest resources has thus been partially investigated and the results represented in Bulletin I, and similar investigations into the dependence of the mining industry and charcoal iron manufacture are awaiting publication.

Notes on wood manufactures.

These notes, taken from various sources, are here given, without vouching for the accuracy of the estimates made, as showing in an impressive way the large consumption of wood material in the aggregate occasioned by our manufacturing industries, many of which are seldom taken into account.

A 2. The annual consumption of wood in railroad building in ordinary times has been computed at over 500,000,000 cubic feet. One copper mine in Butte City used last year 14,000,000 feet, B. M., of heavy timber for timbering its works, and 600 cords of wood daily for reduction and other purposes.

A 3. One of the largest lake vessels requires, it is estimated, about 70,000 cubic feet of oak, furnished by about 2,000 first-class trees, such as can hardly be found in our virgin forest.

Three ore-docks, built in Ashland for the loading of iron ore into lake vessels, consumed over 15,000,000 feet of timber:

From 150,000 to 200,000 wooden pumps made annually consume from 8,000,000 to 10,000,000 feet of poplar lumber.

A 4. The wood manufactures of Chicago are credited with a product for the year 1887 of $34,555,000, nearly $3,000,000 above the output for 1886; the wages paid out in the 390 factories to 18,300 workmen are estimated at $9,356,000.

The door capacity of Northwestern factories is approximated at over 16,000 doors daily, not counting smaller factories; and this manufacture, together with that of sash and blinds, may be roughly calculated to need an annual supply of 50,000,000 cubic feet of raw material.

The product of looking-glass and picture frames alone is valued at $4,871,248.

A 5. Car building increases with railroad building. The timber used in this manufacture must be of excellent quality, and not less than 100,000,000 cubic feet are probably consumed by it at present.

A 6. The material for carriage and wagon building is valued at over $10,000,000, representing probably 25,000,000 cubic feet of wood of special qualities. The serviceableness of the wood for this class of work depends largely upon the manner in which it is grown, and scientific forestry will be able to produce far better material than nature is generally producing.

A 7. Over 5,500 furniture factories are reported in the country, using over $350,000,000 worth of lumber, while the value of wood in sewing-machines alone is estimated at $1,239,400.

A 9. In packing cases a large amount of inferior lumber is used, namely, over $7,000,000 worth, while coffins require $3,762,222, and cigar-boxes round $1,400,000.

A 11. This comprehensive class of manufactures offers many interesting features in the use of wood material and aggregates no mean value, which it would be no small task to ascertain completely.

One Michigan curtain-roller factory, using refuse material from the mills, employs 100 men and must work overtime to meet the demand.

One firm in Maine uses over 100,000 cubic feet of wood, mainly birch, for spools; 160 cubic feet making 1,000 superficial feet of spool stock. Another uses 400,000

feet of spool stock, employing 140 men. Two others use 24,000 to 25,000 cords of wood, chiefly for spools.

One Pennsylvania factory, not the largest, employs constantly 22 men and 14 teams to cut and haul maple logs for the manufacture of umbrella sticks, selling at $6 to $18 a gross. The annual consumption of common umbrella sticks is placed at 8,000,000, mostly of maple.

"One of the steadiest and most profitable wood-working industries is the manufacture of washboards. A great deal of our hard woods could be profitably used in this manufacture, and it is strange that more attention is not given to it."

One firm out of more than a dozen reports a product of over 100,000 butter plates, and there are 30 tray and wooden bowl factories reported.

Clothes pins are a very extensive and profitable manufacture in Michigan, where 5 factories are reported. One New York firm often takes 20 car loads at a time.

Even the wooden shoe, so frequently seen in France and eastern Germany and Russia, has found not only its way into this country, but its manufacture requires even the aid of steam-power to supply the demand. Butternut furnishes the desirable material.

A 12. The cooperage industry uses about $18,500,000 worth of raw material, which can not be less than 225,000,000 cubic feet.

A 13. The shingle product of Michigan alone required in 1887 over 20,000,000 cubic feet of wood, and that of the whole country probably four times as much.

A 15. A New Hampshire firm, one of ten in the country, makes 40,000 bushels of shoe-pegs, using birch and maple, and 100,000 cords are said to be converted annually into this shape.

There are 3 tooth-pick factories in the country, one reported to consume 10,000 cords of wood annually, averaging 5,000 boxes of 70,000 pieces each daily.

Hundreds of thousands of skewers are used annually. They are made by machinery, requiring good-sized logs to work economically, the machine being capable of making 200,000 skewers a day.

Out of a dozen or more match factories, one reports its need of raw material as 4,000,000 feet of best white pine.

Three factories of excelsior, in Grand Rapids, Mich., out of about a dozen in the State, produced last year 6,000 tons of excelsior, consuming nearly 20,000 cords of bass-wood; the material being largely employed in packing, a use unthought of a few years ago.

B 2. One of the 175 wood-pulp factories produces daily 20,000 pounds of pulp from spruce, balsam, Norway, and Jack pine. A West Virginia factory just building is designed to turn out 40 tons of pulp daily. Altogether from 350,000 to 400,000 cords of wood, not of inferior quality, is converted into pulp annually.

C 2. The tanners' industry will probably be the first to find out whether there is any exhaustion of present natural supplies to be expected, and whether it is desirable to think in time for their reproduction. It is estimated that the present tanning capacity of the country requires 3,000,000 cords of bark, or nearly so. Placing the average yield per acre at 10 cords, it would take the bark from 300,000 acres of hemlock and oak growth. How many acres of such growth are still to be had is, unfortunately, not known. Greater economy in the use of the bark is decidedly desirable. It appears that the wastage, mechanical and of tanning principle in the bark, amounts to near 50 per cent. by the old methods in use, while better methods, long in use in Europe, would almost entirely obviate this loss. This subject is of such importance that a methodical investigation into the possibilities of reform has been begun by the Division. It is not likely that when the supply of virgin growth hemlock bark is exhausted hemlock will furnish the tanning material of the future, as it is of too slow growth and contains too little tanning material. With a view to test the possibility of introducing substitutes, the Department has imported seeds of *Acacia pycnantha* and *decurrens*, *Mimosæ*, from Australia, which are probably adapted to the climate and conditions of the sub-arid regions of Texas and other barren sites of the Gulf coast. These trees, producing valuable bark crops in from three to ten years, are sprouters, thus renewing themselves quickly. Their tannic acid contents are sometimes over 30 per cent., as against 7 to 9 per cent. in hemlock and 14 to 20 per cent. in oaks. They are already grown to some extent in California, though perhaps not for their tanning properties.

C 3. The annual maple-sugar product of the country amounts sometimes to over 3,000,000 pounds; the perfection of methods in its preparation, the best mode of treating "sugar bushes," may therefore well deserve attention. It would be a mistake to suppose, however, that this sugar is a substitute for cane or beet sugar, existing in the market only as a flavor and commanding a price as such.

C 4. There are several factories in North Carolina manufacturing pine needles into useful material; one factory produces daily 1,500 pounds of pine-leaf hair and

curled pine straw, sold to furniture and carriage manufacturers for stuffing cushions, chairs, etc. The fiber is also converted into carpets and mattings, and the writer can attest its remarkable wear in his office.

LESSENING WASTAGE IN LUMBER MANUFACTURE.

For an improved veneer cutting machine invented by H. L. Smith, of Brooklyn, N. Y., capable of cutting 60,000 feet of half-inch boards smoothed in the operation, a saving of 37 per cent. in material of such size is claimed. It is also stated that from 1,000 feet of lumber 4,500 staves can be cut, as against 1,800 under the old process.

The value of the circular as compared with the band-saw is formulated by a disinterested English engineer as follows:

MANUFACTURE OF LUMBER BY BAND-SAW.

As regards rapidity of production, the circular saw has at present a decided advantage, producing on an average in White Pine 50,000 square feet of lumber, 1 inch thick, in a day of ten hours, while the band-saw in the same time turns out on an average about 35,000 feet. It should, however, be borne in mind that the circular saw, having been in use for so many years, has probably reached its utmost limit of production, while, on the other hand, the band-saw, having been but recently introduced for this purpose, is capable of considerable further development. This assumption is confirmed by the fact that a band-saw mill of the most approved construction has been known to produce as much as 52,000 feet in a day of ten hours, the product of 102 logs.

As regards quality of work, the advantage is undoubtedly on the side of the band-saw, for whereas it is practically impossible to run a large circular saw at a high velocity without a certain amount of vibration, which naturally produces a somewhat rough surface, a band-saw, being packed immediately above and below the cut, passes through the log in a straight line; and moreover, as the teeth of a band-saw are considerably finer than those of a circular saw they produce a smoother surface.

It is unfortunate that, owing to the question of power being so little considered in America, and to the fact that the application of the band-saw for logs is comparatively new, no authentic tests as to the power required by the latter machine have as yet been made with the indicator; but by comparing the engines usually employed to drive both the band and circular mills an approximate idea on this point may be arrived at. To drive a circular mill with a 6-foot saw an engine with a cylinder 18 inches in diameter, a piston travel of 500 feet per minute, and an average pressure on the piston of 40 pounds to the square inch is generally employed. Such an engine develops 154 indicated horse-power. To drive a full-sized band-mill an engine with a cylinder 12 inches in diameter, working under similar conditions as to piston, speed, and average pressure is recommended. This would develop about 68 indicated horse-power, or considerably less than one-half that required to drive a circular mill.

The last, but certainly not the least important point is the question of waste of wood; and here again the band-saw gives by far the best results. The amount of wood lost in sawdust per cut by a circular saw is five-sixteenths inch; therefore, when producing boards 1 inch thick the waste is 31.25 per cent. A band-saw at most wastes one-eighth inch per cut, or when cutting 1 inch boards 12.5 per cent. Again, to make a board cut by a circular saw, when planed on both sides, hold up to seven-eighths inch, it must be cut 1 inch thick; *i. e.*, one-sixteenth inch must be allowed on each side for planing; while on the other hand, owing to the superior cutting of the band-saw, it is only necessary to allow one-thirty-second inch on each side for planing, showing an additional saving of one-sixteenth inch per cut. This gives a total saving of one-fourth inch per cut by the use of the band-saw.

The foregoing calculations apply to timber of such a size as can be converted by a circular saw 6 feet in diameter; but for larger logs it is necessary to employ an overhead saw, and as the tracks of the two blades never exactly coincide, the boards thus sawn show a joint, which necessitates a still further waste of wood. This objection does not apply to the band mill, which will saw through logs of any diameter.

It is thus evident that for the conversion of pine logs the balance of advantage lies distinctly with the band-saw; and if this is so in the case of comparatively small and cheap timber, it is certain that for the more valuable descriptions of hard woods, which frequently run to very large sizes, these advantages would be enormously increased; and it is not too much to say that the band-saw will in a few years be universally employed in preference to any other machine for the wholesale conversion of timber.

III.—FOREST POLICY, OR INVESTIGATION INTO AND AFFECTING THE RELATION OF THE STATE TO FORESTRY.

The new, the American, school of economists has formed a larger conception of State activity, of national existence, and of our obligations as a government to the future than the old school, which considered government as something outside of ourselves, and would try to frighten us like children with the cry "paternal government" whenever it was proposed to enlarge the sphere of State initiative, whenever a wider view of our existence as a community, as a nation, would call for an extension of State powers. We are gradually learning to recognize theoretically, with the new school, that police duties do not exhaust the proper functions of the Government, while practically we have never allowed the principles of the old school to prevail. The eminent domain exercised over waters, roads, and air, the active aid given by the Government in establishing communication, in fostering education, in advancing science, and placing commerce and industries upon a rational basis seem capable of extension, and for various reasons such extension of Government activity appears desirable with reference to the forest areas and forest industry of the country.

The forest without doubt has another very different and more important economic significance for human society than simply to provide it with wood and other forest products, or to represent only a source of wealth. An improvident, ignorant, haphazard, or negligent treatment of this gift of nature, for which there is no substitute, can injure and endanger not only the best interests of the proprietor himself and of his children, but the weal of many who do not share in its ownership; that of nations may be dependent upon its proper management. The forest, therefore, is to some extent a common property of all; like air and light, it has for all an incalculable value. It is perhaps the most important factor in the economy of nature and of man.

Therefore, every man who has an interest in society and the welfare of humanity must have an interest in and contribute according to his power towards the conservation and improvement of favorable forest conditions and avoid all that tends to deteriorate, diminish, devastate, destroy the same, where they serve such indirect purpose, and the State as the person most interested in this function of the forest may need to be called into requisition to keep it in working order.

To ascertain the basis upon which such government activity is desirable, and the methods by which it is best exercised, will be the object of this line of investigations.

In the first place it is claimed that the State has an interest in the perpetuation of certain forest areas on account of their influence on the general favorable conditions of the surrounding country, a consideration which can hardly be expected to enter into the actions of the private individual.

This claim has been based partly upon historical experiences, partly on experiments and logical inferences. The experiments have been made mainly in Germany and France during the last twenty-five years, and although the existence of local influence of the forest in various directions, and especially upon the equalization of water-flow has been undeniably shown, the results so far allow but little generalization. It will be necessary to conduct special experiments to

establish at least the degree of influence exerted by forest areas in our own country if we expect to proceed upon a rational basis as regards State action on this account.

There are also some commercial peculiarities which distinguish the forestry business from all or most other industries—the length of time before the investment is returned in the crop being one of them—which call for special consideration.

The study of the history of the forestry development in this and other countries as a basis of the discussion of the needed legislation on forest police, and State forest administration, on educational requirements, etc., lies also in this line of investigations.

C.—The **practical basis** of forestry, or knowledge of forestry practice.

While the divisions under A and B comprise the general considerations upon which forestry is to proceed, the special knowledge necessary in applying natural and economical laws to forestry practice remains to be considered. This, to some extent, is derived by deduction from the previous studies, by giving them a practical direction, and is supplemented by experience and experiment. It is the record of results in application upon the management of forest areas, and has consequently the greatest interest for the active forest planter and forest manager.

While the studies outlined in the former divisions furnish answers principally to the questions of common parlance, what to plant and where to plant, under this head we would answer the question, how to plant.

Here would be discussed the methods to be employed in obtaining a reproduction of the natural forest, and in artificial reforesting of cleared or waste places, which involves also a knowledge of the nature and the manner of handling the seed and growing seedlings to be used in the operation.

Having started the crop with a full appreciation of the results and objects to be attained, there remains much to be done in managing the crop until it is utilized, if we wish to achieve the best and quickest results, and if the forester wishes to be (as he ought to be, even more than the farmer) a good financier, this part of his work is almost of more consequence than the mere planting of the crop.

In the past, forest and forestry have meant, in the English language, nothing more than woodlands and woodcraft, without any consideration of system or management, or regard for the relation of forests to national economy, except so far as nature's growing was cut and utilized. Tree-planting, then, and perhaps lumbering, came to be called by the name of forestry, and are even now by the many considered identical with it, while in reality they are only some of the incidents of forestry. With the conception of the rôle which the wooded areas play, or are to play, in the economies of a nation, we must place a more significant meaning and a restricted sense upon these words. Forestry, systematic forestry, is a business like agriculture, an industry which is concerned in the production of a soil crop. It is the art of managing a wood crop so that it will make the best harvest of timber in the shortest time, and the best means, of course, the best paying. This at least is, and will be for some time to come, the only incentive for private forestry, for the climatic and hydrologic influence of the forest, which must form an important consideration in State forestry, will only be an incidental consideration with private forestry, except perhaps on the treeless plains.

Thus all manipulations and expenditures of management must be weighed with reference to a financial result, and as the crop takes many years to mature, the calculation is often quite complicated and delicate, and as the margins are small and the factors entering into calculation uncertain, many accurate measurements and constant adjustments become necessary wherever forestry has become a settled business, as in Germany. In fact, the modern German forester can be said to be principally a mathematician and a financier, who handles large capitals on small margins. The art of growing and utilizing the forest with him is based on close financial calculation, the basis for which has been obtained by numberless measurements under actual forest conditions. All discussions of methods of management are turned at once into financial problems, and a special science of forest finance calculation has within the last thirty years been elaborately developed, from which experience tables are constructed.

Altogether, however, this fine financiering has not yet been reduced to such a safe basis that we can with certainty answer the various questions of interest to the pocket of the forest manager. Many of the premises in the calculation are, if not wrong, entirely too uncertain, and in practice the forester is left to do "the best he can," and to gather and work upon "experiences." Our time for close calculation has not arrived. Does forestry pay? is a question which can only be answered locally, under given momentary conditions. But conditions with us change rapidly, and what may not appear of even prospective value to-day may possibly turn into the richest gold mine. The prospect is that a man who now invests in forest growth and attends to its management will, at the time of harvest, be repaid a hundredfold, without close financial calculation. At the same time it will be well to begin in time to provide the factors upon which a more definite calculation of the material or financial results of different methods of management depend. Then only shall we be able to answer confidently and fully such questions as, When is it best to thin? What is the best time to utilize the crop? How do the financial results of natural reforestation and artificial planting compare? Methodical measurements and systematic experiments are almost entirely wanting which would give specific, trustworthy answers to these questions, and determine, for instance, the effect of different methods of cultivation upon the development of the crop, the degree and the time of thinning most suitable for the different species, the most suitable mixtures, etc.

Some notes of a general character touching this branch of forestry investigations will be found further on, and a manual on forest planting will be ready for publication when opportunity offers.*

* To give an idea simply how such calculations affect practical questions, it must suffice here to submit one example:

An acre of forest has cost to plant $12; when thinnings are made in the 30th, 40th, and 50th years the yield will be, according to experience tables and reckoned at present prices, say, $3.40, $9, $13.60, respectively, and in the 60th year the growth may be cut and will yield $350. When, however, the thinnings are made in the 30th, 43d, and 53d years, they will yield $3.40, $10, $13.90, respectively, and if cut in the 62d year, the yield will be $340. Which is the most profitable management? It would lead too far to develop here the method of calculation, but we shall find that the present values of the different yields, discounted at 3 per cent. (the rate at which German forests pay in the average), are in the first case $65.84, in the second case $58.94, making the first management appear the more profitable.

The system thus outlined, brought into a bird's-eye view, will give to the student of forestry a conception of the manifold directions in which his attention may be drawn.

This system of forestry, as a science, although containing, it is believed, a shelf for any work that may have a bearing upon forestry, does not coincide with any in vogue in the countries of Europe, where a different degree of development would change the value and with it the co-ordination or subordination of the different subjects. It is believed, however, that by the presentation of such a systematic arrangement of the topics demanding the forester's attention, the educational advancement of the science in this country will be subserved, and students interested in forestry will find in it an aid to their studies, and will be induced to work out certain lines and bring together the knowledge with which to build up American forestry.

A.—Scientific basis of forestry.

I. *Forest biology.*—(Consideration of the growing crop.)

1. Timber and forest physiology. Life history of species in their individual and aggregate life.
2. Forest geography. Floras and their distribution.
3. Study of forest weeds in their relation to forest growth.

II.—*Timber physics.*—(Consideration of the grown crop.)

1. Anatomy of woods.
2. Chemical physiology of woods.
3. Physical properties of woods.
4. Influences determining the physical properties.
5. Diseases and faults of timber.

III.—*Soil physics and soil chemistry.*—(Consideration of the conditions for growing a crop.)

B.—Economic basis of forestry.

I. *Statistics.*

1. Forest areas.
2. Forest products.
3. By-products.
4. Prices, trade, substitutes.

II.—*Technology.*—(Applied timber physics. Needs of wood consumers.)

1. Methods of harvesting (lumbering) and preparation for market, including improvement of machinery.
2. Economy in the use of product.
   a. Utilization of waste material.
   b. Methods of increasing the durability of timber.
3. Special needs of consumers of forest products.

III. *Forest policy.*—(Determining the relation between forestry and the purposes of the State.)

1. Forest influences.
   a. Influence on temperature and electricity.
   b. Influence on humidity and rain-fall.
   c. Influence on winds.
   d. Influence on water-flow and water-level.
   e. Influence on soil, formation of avalanches, shifting sands, dunes.
   f. Influence on health and fertility (and ethics).
2. Commercial peculiarities, position of forestry in political economy.
3. History of forestry.
4. Forest police, formulation of the rights and duties of the State and of its methods in developing forestry; legislation, State forest administration, education.

C.—Practical basis of forestry.

I.—*Origination of the forest.*

1. Artificial afforestation.
   a. Procurement of seed and other plant material.
   b. Nursery practice.
   c. Choice of kinds for pure and mixed growth.
   d. Methods of preparing soil.
   e. Methods of forest planting.
2. Natural reforestation.
   a. From seed.
   b. From the stump.

C.—Practical basis of forestry—Continued.

II.—*Management of the forest and forest regulation.*

1. Methods of improving and accelerating the crop.
   - *a.* Cultivation.
   - *b.* Filling.
   - *c.* Thinning.
   - *d.* Pruning.
   - *e.* Undergrowing.
2. Methods of improving forest conditions.
   - *a.* Road making and facilities of transportation.
   - *b.* Survey, division into blocks, marking, and booking (describing) area.
   - *c.* Protection against fire, water, shifting sands, climatic influences, insects, cattle, abuse of pasturage, etc.
3. Methods of management.
   - *a.* Timber forest.
   - *b.* Standard coppice.
   - *c.* Coppice.
   - *d.* Method of "selection" and other methods.
4. Forest regulation.
   - *a.* Ascertainment of rate of accretion; methods of determining accretion in mass; value; yield.
   - *b.* Ascertainment of proper rotation and determining yearly or periodical cut.
   - *c.* Regulation of the use of forest by-products.

III.—*Harvest.*

1. Methods of cutting, with a view to natural reproduction; progressive fellings.
2. Methods of securing most thorough utilization of product.

EXPERIMENTATION.

In view of the liberal appropriation given by Congress for the purpose of establishing or aiding existing Agricultural Experiment Stations, it is to be hoped that the provision of the bill which calls for experiments in forestry will not be overlooked, nor action upon this class of experiments delayed, since it takes many years to conclude most forest experiments with sufficient results to generalize upon.

There is a difference, often not well understood, between results of experience and results of experiments. Experience notes results, often without full cognition of the special conditions under which the result has been obtained, and hence they are often incapable of generalization. Experiment takes note of or establishes certain conditions and ascertains their special bearing upon the result; it establishes principles, it tests experience, and makes practice sound. It establishes rules for the practice derived from exact and methodical investigations, and makes them available for general application. Experience is nature's slow process of teaching; experiment is man's intelligent improvement of nature's method. It saves time and therefore money, and hastens the development of that knowledge which experience brings but slowly and imperfectly. It establishes the connection between theory and practice.

While it is apparent to the intelligent student that no practice can exist without theory, the so-called practical man, or he who calls himself such, is apt to overlook the fact that his practice, if successful, is based upon some theory or some natural law which was discovered so long before he began to practice upon it that the theory has been forgotten, the connection between theory and practice has been lost. In fact it will be found that this practical man in reality theorizes more than the professional theorist, only upon a less safe basis, for he attempts to generalize from too little successful practice,

and often without recognizing the conditions which made his practice successful and the difference of conditions which would make the same practice unsuccessful elsewhere.

Experiments systematically and methodically conducted are therefore the handmaidens of reliable and successful practice.

While all advocates of forestry have insisted upon the necessity of forest experimentation no one, so far as I have been able to find out, has expressed himself clearly as to the precise purpose for which experiments should be instituted or the precise experiments which it would be most desirable to begin first.

The only positive proposition which I have met with has been to give answer to the question, "Does forest planting pay?" This, to be sure, can be ascertained by experiment stations only incidentally if at all. Such experiment in the desired direction being devoid of result for many years should certainly not form the subject of an experimental question.

In a country which, like ours, is as yet not developed in all its parts, the price of any commodity, which, like that of our forest products at present, can still be supplied in abundance from natural resources, must be dependent on the degree of development, the accessibility of natural supplies from all parts of the country, rather than upon the local conditions of supply and demand. Moreover, the price for wood products, at least those which it takes a long time to produce, must change, and that rapidly, and beyond the possibility of positive calculation. The question "Does it pay?" can not be one for general answer by experiment, but must be answered rather by inference, based upon statistical research. The farmer who in the treeless region has early set out his trees for the purpose of windbreaks and comfort to-day probably has his answer to the query in the affirmative, while the experiment station of Champaign, Ill., has to give it in the negative; and in ten years further the parties will perhaps have exchanged positions, views, and experience on the subject.

The Experiment Station can inquire into the elements which comprise the cost of production. It can also inquire into the quantity and quality of wood produced in different periods of time under varying conditions; but it is powerless to determine the market price, the demand and supply for different materials.

There are to be found in Vol. III of Forestry Reports from this Division over twenty pages stating the general aspect rather more than the general plan of work for forest experiments. This general outline of a working plan is attempted in the following suggestions.

The work which Experiment Stations could undertake properly does not necessarily confine them to nursery or field experiments. In fact, the necessary basis for a profitable field experimentation is still almost entirely lacking, and before we can lay an extensive plan for such we should first gather the elementary knowledge upon which we can proceed to build an extension by means of experimentation. The investigations outlined in the foregoing pages will have to be carried further before we can intelligently formulate specific questions for experiment. Yet we can make a beginning, and the following division of work to be undertaken by the forestry experimenter is proposed in the furtherance of a systematic development and progress in forestry science. We may classify these experiments as follows:

A. Experiments in the forest.

B. Experiments in the nursery or the field.
C. Experiments in the laboratory.
D. Meteorological and phenological observations and experiments.
E. Climatic observations and experiments.

A.—Experiments in the forest.

This class of work can be performed only where a natural forest growth is connected with the station or is within easy reach and under its partial control, as may no doubt often be obtained from private owners.

(1). *Tree analysis*, *i. e.*, careful measurements of trees, which may be made either on trees cut for the purpose or cut for use, serve to furnish the basis for determining the rates of growth in different species at different periods of life, and to establish factors of shape. Such work will be of the highest interest to those who ask, "Does forestry pay?" They want to know what material they can expect a tree and a forest to produce, and these measurements, carefully conducted, furnish the only means of answering that question satisfactorily.

Moreover, the knowledge of the relative rate of development of different species in different stages of life under different conditions, obtained by such measurements, is absolutely necessary when advising upon proper mixtures and methods of cultivation and upon proper forest management. The yield of wood in a forest growth depends upon the number of trees and the mass of each tree. This mass is the result of height and diameter development. It is known that the absolute height accretion, as well as the periodical or yearly average height growth, differs in different species. This difference is especially noticeable in young trees, and the most vigorous height development generally occurs at an age of between thirty and forty years, after which the height growth declines in those species which grow into branches, while it continues at a fair rate for a long time in those which develop the shaft in preference to the branches (firs, spruces, larches). It is also known that those trees which are habitually inclined to branching are also much more susceptible to the modifying influences of external conditions, such as moisture, depth, looseness of soil, nature of subsoil, altitude, winds, and density of growth, the latter being perhaps the most powerful promoter of height growth with these species.

As regards diameter development under normal conditions, this appears to be in proportion to height growth, so that the period of greatest height growth shows also the greatest diameter development. This period seems to occur earlier with species which are dependent for their development upon a large amount of light than with the shade-enduring ones, light influence seemingly being the most powerful factor in determining the absolute diameter increase, in regard to which we shall speak further on.

The diameter decreases towards the top in very varying degrees, according to the more cylindrical or conical form which the tree affects. This difference of form depends not only upon the species, but also upon soil conditions and other outside factors of site which influence growth. For determining the technical and financial value of the species, the knowledge of the typical development of the species under given conditions, must evidently be very desirable. Having, by many measurements, arrived at accurate results which

express the typical factor of shape, it is easier to determine the periodical mass accretion which belongs to a species under given conditions at a given age, and we can begin to speak on a rational basis of the desirable choice, and the possibilities of species from a financial point of view, for which at present none but incomplete local, therefore unsatisfactory, notes of experience exist. A few such methodical measurements have been kindly undertaken by Mr. J. E. Hobbs, of Maine, for use in the monograph on the White Pine, by Professor Spalding, who, in his report, says:

> The plan for taking measurements and recording external conditions and surroundings, devised by the Chief of the Forestry Division, has proven to be admirably adapted to the end in view, and my main regret is that it was found impossible, through lack of competent assistance, to measure a larger number of trees under different conditions of growth.

The schedule and copy of the record of a single tree is as follows:

Tree No. 15.

[Position of crown: free, partly free, crowded; associated species: oaks.]

a	*b*	*c*	*d*	*e*	*f*	*g*			*h*	*i*	*k*	*l*										*m*
					Stump.				Sections.													
Diameter breast-high.	Length of timber.	Diameter below crown.	Length of crown.	Length of leader for last 5 years.	Height.	Diameter at top.	Age.	No. rings on stump.	No.	Length.	Diameter at top.	No. rings at top.	No. rings in sap.	Thickness of sap.	No. rings for every inch on radius.								Thickness of bark at top.
										Feet.	Inches.			Inches.	1	2	3	4	5	6	7	8	9	10	
In.	Feet.	In.	Feet.	In.	In.	In.	Yrs.		1	19	20	97	29	2	15	14	13	10	9	8	8	8	8	4½	½ inch.
									2	$20\frac{10}{12}$	$17\frac{1}{2}$	79	24	$1\frac{3}{4}$	16	14	10	10	7	6	6	7	$3\frac{1}{2}$	....	¼ inch.
28	$51\frac{7}{12}$	16	55	30	10	27	5	117	3	$20\frac{8}{12}$	14	64	19	$1\frac{1}{4}$	13	13	7	8	9	8	6	....	....	....	

n																		
At.....(feet)..	4	8	12	16	20	24	28	32	36	40	44	48	52	56	60	64
Diameter..(inches)..	23	$21\frac{1}{2}$	21	$20\frac{1}{2}$	19	19	19	$18\frac{1}{2}$	18	$17\frac{1}{2}$	16	16	$15\frac{1}{4}$	$13\frac{1}{2}$	13	12

[Age of tree, 122 years; total height, $107\frac{5}{12}$ feet; spread of crown, 27 feet.]

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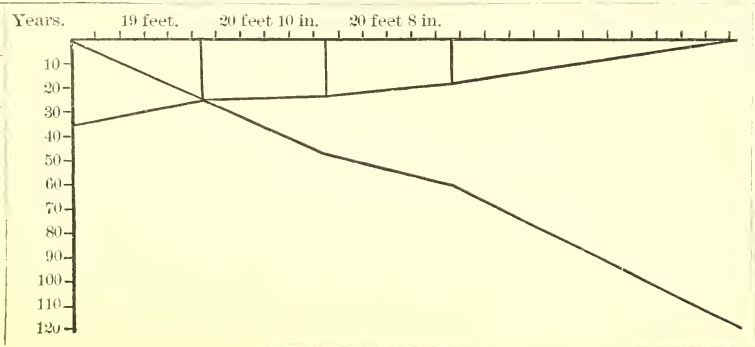
Height.	
Age of tree.	From ground.
Years.	*Feet.*
25	$19\frac{9}{12}$
43	$40\frac{8}{12}$
58	$60\frac{4}{12}$
122	$107\frac{5}{12}$



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Height (feet).	In the—	Height (feet).	In the—
8	10th year.	70	70th year.
17	20th year.	77	80th year.
26	30th year.	85	90th year.
37	40th year.	92	100th year.
49	50th year.	100	110th year.
62	60th year.	$107\frac{5}{12}$	120th year.

The instructions for measurements which appear on the back of the schedule contained the following points:

Number trees measured in same camp and conditions consecutively. Underscore the word denoting position of measured tree, whether standing free or crowded, and give surrounding species.

Use 4-foot rule and gauge. In all cases, if possible, take two measurements of diameter at right angles and note average.

(*a*) Take diameter about 4½ feet from ground (breast high), or from the collar of roots if soil has sunk away.

(*b*) Timber: From butt to first limb of crown.

(*d*) From first crown-forming limb to top.

(*e*) Found by cutting leader off and back until only five rings can be counted.

(*f*) Height: Taken from ground or collar. Age: Supposed number of years for the young tree to have attained height of stump (three to ten years).

(*h*) Sections are numbered, beginning with butt section.

(*l*) Count along a rule laid across the heart of the cut, beginning from outer circle; note number of rings at each inch. If radii are of different lengths, as is often the case, then find average radius to count on.

(*m*) Measure diameter with gauge and the wood with rule; difference will give double thickness of bark.

Age of tree is found by adding columns *f* and *g*.

Heights, by adding columns *f* and *b* and *d*.

(*o*) Ages found by deducting each count in *k* from age of tree.

Heights, by adding to (height *f*) lengths in *h*, consecutively.

(*p*) Found on graphic chart by interpolation.

With a large number of such measurements carefully made and properly compiled a good mathematician will be able to give advice as to what rate of growth and what yield may be expected from each species, with more assurance of being right than the oldest practitioner with his limited experience.

The instrument used for measuring is a caliper square, a rule carrying two cross heads (about 2 feet long) at right angles, one fixed, the other movable along the rule (somewhat like a shoemaker's measure); the rule is made just 4 feet long to facilitate measuring of lengths.

Samples of wood for technological and physical analyses, as outlined further on, may be procured opportunely when making these measurements.

(2) *Interlucations and undergrowing.*—If it is in the power of the station to subject a considerable forest area to an experimental forest management, the influence of various degrees of thinning (interlucation), the advantage of producing undergrowth in an old forest, as well as the best kinds and methods for such undergrowing, can be determined.

Forestry, to be profitable, must strive to shorten the time in the production of sizeable timber for useful purposes, for it is the length of time required to produce such timber, to mature the crop, that distinguishes forestry from all other industries. This so important factor of time, which nature in her reproduction does not take into account, must be an object of constant consideration on the part of the forester who would succeed financially, for the successful forester must be able to balance properly three desiderata: the rapidity of full development, which is aided by a free access of light, air, heat, and increased feeding room; the preservation of favorable soil conditions, which is aided by a constant shading of the ground; and clean shaft development, which requires a more or less dense growth of the trees.

While the single tree may in the full enjoyment of the light have the greatest accretion in an open growth, there are fewer trees in such a growth, and therefore the total yield per acre may be less. On the

other hand, too dense growths, such as nature often produces, not only make less wood but also inferior sizes within the same period than more open woods, in which the young plants could grow vigorously from the start. A thinning out of such dense sowings at an early period would hasten the individual development and the decision of supremacy which some few hundred of the individuals are destined to gain over the weaker ones.

There must be for every condition of the forest, for every species, every age, and every site, a certain limit where just the right number of trees standing produce a maximum accretion, the greatest total yield, without impairing the other two considerations of clean growth and soil protection.

While some trees thin out by themselves sooner and more easily than others, some need the aid of the forester more often to assist in their development. Periodical interlucations or thinnings are the best means of regulating the development and accelerating the material and financial object of the forest.

What is the proper time for such interlucations? how often should they be repeated? to what degree should light, air, and space be given to the remaining growth without impairing the other two considerations of a clean growth and soil protection?—these are questions which experimental forest management should solve.

The first mention of thinning for the purpose of benefiting the remaining growth dates back at least to the year 1547, but ever since the practitioners have differed more or less in regard to the manner in which to proceed. The golden rule, "early, often, moderately," has found the largest number of followers, each one differing as to the precise meaning of the prescription; but the most advanced teachers of forestry seem to see the advantage of more decided interference in the development of forest growth and are about to prove by experiment the superiority of their doctrine. That the time and degree of thinning must differ with the different species, different soils, and localities, needs hardly to be mentioned. A few records of actual results, reported from reliable sources, may serve as suggestions and illustrations of the importance of this line of experiment:

A natural growth of pine (Scotch) which was thinned when six years old showed an increased rate of accretion three times as great as that of the part not thinned, which was also deficient in height growth.

A fifty-year-old spruce (Norway) growth, having been twice thinned, showed an average accretion 22 per cent. greater than the part not thinned.

A growth of spruce (natural sowing), slightly mixed with maple, aspen, willow, and iron-wood, when fifteen years old was opened to the poor population to take out fire-wood; thus one-half of the growth for a few years was thinned out irregularly. The pa t thus thinned eighteen years later contained four and one-half times more wood than the undisturbed part; the former contained trees of from 1 to 9 inches in diameter and 15 to 65 feet in height; the latter did not produce any trees above 5 inches in diameter and 48 feet in height.

Another experiment, made upon a pine growth fifty years old, showed that by interlucation the rate of growth within eleven years stood three to one and three-fourths in favor of the thinned part.

Another writer planted Scotch Pine 6 feet apart; two years later he planted the same ground to bring the stand to 3 feet apart; he thinned when fifteen years old, and carefully measured contents when twenty years old. Although the plantation was stocked on poor soil, yet the average annual accretion was found to be 2.43 cords (Austrian) per acre, a yield "which is unexcelled." The writer adds that "if in such growths the number of trees is reduced in the fifteenth to twentieth years to 280 trees per acre, the yield in sixty years might equal that obtained in one hundred or one hundred and fifty years in the old manner."

A plantation of Norway Spruce, made with seed, was when thirty-three years

old still so dense that it was impenetrable; hardly any increase was noticeable ar the trees were covered with lichens. When thirty-five years old it was thinned, ar again, when forty-two years old the condition of the growth was such as to make thinning appear desirable; between the two thinnings, within seven years, tl accretion had increased by 160 per cent., or 27 per cent. yearly in the average, ar the appearance of the trees had changed for the better.

A coppice of Tanbark Oak was thinned when fifteen years old on half tl area; when twenty years old both parts were cut, and it was found that the thinne part yielded more wood and more and better bark than the unthinned part, ar yielded in money 14.5 per cent. more, although no higher price was asked for tl better bark.

An area of 12 acres was planted, one-half with two-year-old pine seedlings fro the forest, the other half with seed.

Three thinnings were made with the following yield of round fire-wood (cut t billet length and over $2\frac{3}{4}$ inches in diameter) and brush-wood (less than $2\frac{3}{4}$ inches i diameter).

The planted part yielded at the thinnings:

When—	Fire-wood.	Brush.*
	Cords.	*Cords.*
10 years old	1.4	1.(
15 years old	4.9	2.1
18 years old	4.5	2.1
Total	10.8	7

The sowing was first thinned when eight years old, yielding:

When—	Fire-wood.	Brush.
	Cords.	*Cords.*
8 years old		2.8
10 years old		3.6
20 years old	3.2	1.4
Total	3.2	7.8

In twenty-four years the total yield, inclusive of thinning, was:

	Cubic feet c solid wood
Planted part	3,49
Sowed part	1,99
In favor of planted part	1,49

The following records of trials with different widths of planting belong in the same class of investigations, since the experiments a to the best methods of thinning reduce themselves to the question o the most advantageous number of trees to be grown per acre:

Two areas with the same soil conditions were planted with beech (with sod), si years old: A, at distance of 6 feet; B, at distance of 2 feet.

	Fourth year (best trees).		Fifteenth year (best trees).	
	Diameter.	Height.	Diameter.	Height.
	Inches.	*Feet.*	*Inches.*	*Feet.*
A	3.9	$24\frac{1}{2}$	7.7	50
B	1.7	$18\frac{3}{8}$	4.3	42

* It is perhaps fitting to note here that a greater economy of wood is observed in European forest than has as yet appeared necessary to American woodmen. This close utilization of even inferior woo appears from the classification of fire-wood in Prussian forests. Besides the split or clear body cord wood, over $5\frac{1}{2}$ inches at the small end, and the lim wood, $2\frac{3}{4}$ to $5\frac{1}{2}$ inches at small end, there are 4 sub classes of brushwood, of which the first class comprises round wood under $2\frac{3}{4}$ inches in diameter, cu to billet size; the second class, inferior brush from thinnings, not cut to size, including all the smalle twigs.

From this record it becomes doubtful whether dense position, within limits, does even favor height growth.

Such records could be multiplied indefinitely and supplemented by tables of exact measurements, etc., but the results here given will suffice to show the general direction in which experiments on thinning should be made. These experiences and experiments in German forests have only a general application with us, and we shall have to work out their specific application to our species and conditions by special experiment. Besides, even in Europe, opinions, rather than exact knowledge, still determine the manner of thinning, the best time, the degree and the repetition of the interlucation. The importance of this question may excuse its lengthy discussion here to the detriment of other parts of this report.

The question "Does it pay?" so eagerly asked by all would-be forest planters finds a partial answer in the settling of the questions of proper thinning.

Summarizing the objects of experiments on thinning (interlucations), we may say, that by them we endeavor to ascertain the influence which an interlucation, earlier or later, repeated at shorter or longer intervals, executed more or less severely, will exercise upon the height and form of forest growths, upon their yield in thinnings and ultimate crop at different periods of their life, and upon soil conditions.

LIGHT INFLUENCE UPON TREE GROWTH.

In the discussion of this and many other questions of forest management too much importance can not be placed upon the proper consideration of the influence of light upon the development of various trees in the forest. In last year's report I have alluded to the relative dependence of the different species for their normal development on proper light supply, and shown the necessity of taking this factor into consideration in the planting and managing of the forest. Since then two new contributions to the knowledge of this subject have been made. The one is in the form of a new handbook on forest planting by the director of one of the Prussian forest academies, Dr. Bernard Borggreve, in which many, if not most, of the prevalent ideas regarding this light influence and the consequent rules for forest management are severely criticised and overthrown or modified by reasoning rather than by facts. The second is a discovery, not yet published, of Dr. M. Kienitz, by which the physiological cause of the difference in the behavior of different trees under light influence has been shown, and which, to some extent at least, seems to justify the prevalent ideas and rules.

It is a well-known fact that light is necessary for the development of chlorophyll, and therefore for the life of all green plants, and especially for tree life and wood formation. Heat alone, which practically always accompanies light, is not sufficient for this purpose, although it is still an open question as to what the absolute light requirement of a tree species may be, or how much of the effect of increased light on growth is attributable to the light alone and how much to the accompanying heat. Yet it is undeniable that there exists a relative difference of light requirement not only for different species of trees, but for all other plants. In last year's report I alluded to this difference in regard to the forest weeds, which serve in forest management as an indication of the amount of shade which the trees exert, and with that their capacity of impeding evaporation from the soil. While the rosin weed, sunflowers, some of the golden rods (*Solidago*

nemoralis), and some of the meadow grasses, and the fire-weed (*Erechthites hieracifolia*) may be mentioned as requiring full sunlight for their best development, the Indian Pipe (*Monotropa*) is most decidedly a verse to a high degree of light; the partridge berry (*Mitchella repens*), and among the grasses *Poa flexuosa, brevifolia, Festuca nutans, Cinna arundinacea* may be named as seeking the shade. The Ground Hemlock and Rhododendron are also characteristic shade plants. By careful observation we could make a classification of weeds characterized by their dependence for normal development on various degrees of light and shade.

The frequently observed change or "alteration" of the flora, when the original forest is removed, must to some extent be explained by this light influence.

The amount of light required is, however, considerably modified by other influences of site. Where the intensity of the sunlight is great, as in southern countries, in higher altitudes and in drier climates, and also where the growing season is longer or the number of sunny days greater, a shade-enduring species will be able to sustain still more shade, and a light-needing one may even become shade enduring. The flora of high altitudes, therefore, is in general decidedly light needing; the elms, oaks, and ashes, which in northern latitudes are clearly light needing, may in southern latitudes endure considerable shade.

Trees are no exception to this rule, and, while nearly all develop best, *i. e.*, make the most wood in the full enjoyment of light, their capacity of preserving their vitality and of developing under the shade varies greatly. While the yew will thrive in the densest shade, a few years of overtopping will kill the larch; so also, while the beech will grow with considerable energy under the partial shade of such trees as ash, maple, etc., the oak will only just keep alive under the same conditions, and some of the birches would die.

Favorable moisture conditions make all species less sensitive to the withdrawal of light, and here perhaps the influence of the heat which accompanies the sunlight plays an important part. Therefore, on the fresh soils of bottom-lands, on northern exposures, and in the coves and depressions in the mountains the light-needing species will be found to suffer less from shading than on dry, poor soils; even so shade-enduring a species as the spruce becomes sensitive to the withdrawal of light when growing on drier mountain sites. The observations by which we may arrive at a relative classification of our timber trees with regard to their light requirements must therefore be made with due consideration of these modifying influences. The capacity to withstand shade, even in later life (in their youth most trees will stand considerable shade) is noticeable in the denser or less dense foliage and in the capacity of overtopped individuals or overshaded branches to preserve their vitality for a longer or shorter time. The observations on this line must then be made in the dense forests, in order to be able to judge of their characteristic foliage development in the shade. For if grown in the open, so much light is accessible to every part of the crown that leaf development even in the interior of the crown is unimpeded, and quite a dense foliage is the result. Thus in the open, the Maples, Elms, Sycamores, Black Locusts, etc., make good shade trees, while in the dense forest they thin out and have but scanty foliage. The conifers, which, like the spruces and firs, preserve the foliage of several years, have perhaps the greatest capability of growing under shade

and preserving their foliage in spite of the withdrawal of light. But in the present state of our knowledge we become painfully aware that we are lacking sufficient data to group even our most important forest trees in a series according to light requirements. This is not so, however, in Europe. Some forty years ago German foresters made observations along this line, formulating them and elaborating rules for the management of the various species, especially in thinning, mixing, and cutting for reproduction; and, although these rules have been practiced for so long a time based on empirical knowledge, it is only now that Dr. Kienitz offers a physiological explanation of the difference in the behavior of trees under changing light conditions. He found that on the same branch those leaves which are developed under the full influence of the sunlight are not only, as was known before, often larger and always tougher in texture and thicker, but they have a larger number of stomata (or "breathing pores") than those formed under less exposure to sunlight. The same, of course, was observed in individual trees grown under shade and in full enjoyment of light. If, then, the trees which have their foliage formed under the shade of outgrowing neighbors are suddenly placed in different light conditions, the foliage is not adapted to perform its function as energetically as the stronger light necessitates. The buds which are formed in deficient light show also in their leaves a deficiency in the number of stomata, and in consequence the favorable influence upon wood formation, due to increased light, for which the thinnings and interlucations are made, become in fact noticeable only the second year, when new buds, developed under the increased light influence, have formed leaves adapted to the changed conditions. In conifers, which hold their leaves for several years, this adaptation naturally takes a much longer time, and under unfavorable conditions, if moved too suddenly from the shade into the light, they often lose their old foliage and even die before the new foliage adapted to the light influence is sufficiently developed to sustain the increased demand of respiration, transpiration, and assimilation.

The importance of this knowledge becomes apparent when we attempt to formulate the rules for thinnings, etc. There is hardly any line of investigation, observation, and experiment more fruitful and more needed for the practical purposes of forest planting and management than to establish this relation of our timber trees to light conditions. The rational compositions and form of our plantations, their management and reproduction, are based upon this knowledge, and the proper application of it may be well termed the essence of forestry.

Observations and experiments, therefore, in regard to the dependence of our important timber trees upon light conditions are among the first to be undertaken by the Experiment Stations in the forest and in the nursery.

Hand in hand with these experiments will go, of course, the inquiries into the rate of growth and yield before alluded to. If there are old growths at hand, the influence upon the yield of thinning with consequent "undergrowing" may be ascertained.

INFLUENCE OF "UNDERGROWING" ON THE ACCRETION OF THE PRINCIPAL GROWTH.

While it might be expected that a tree in the full enjoyment of light would produce more leaves, and therefore more wood, than

the one that is narrowed in by neighbors, on the other hand, the dry ing effect of sun and wind upon the soil would tend in the opposit direction, and thus the densely shaded soil offers more continually favorable conditions of growth than the open, bare, or sodded ground

To balance these two factors of growth so as to produce an opti mum is one object of forest management.

The beneficial influence which undergrowth exerts upon the phys ical conditions of the forest soil, especially in preventing undue dry ing out by surface evaporation, is so well recognized that the estab lishment of such undergrowth often forms an important part o forest management. The beneficial influence upon the soil is natu rally reflected in the prosperity of the principal growth.

The writer has seen a number of oaks, some eighty years old which were left standing on a clearing to grow on for the next "ro tation," sickening and dying at the top. As soon as the young growth of hard wood underneath had covered up the foot of these oaks, they revived, recovered fully, and grew vigorously.

Observance of these effects of light on the crown and shade at the foot has given rise to a management by which either a well-grown forest is thinned out, leaving a certain number of trees to produce more quickly heavy sizes under the increased light influence, and un derplanting these for the purpose of preserving good soil conditions or else a naturally thin stand of trees may be so undergrown as to improve the production of the principal growth.

Such groves are not unfrequently found in Germany, where the villagers have tried to combine pasturage with tree-growth (mostly oak), by which the latter usually got the worst of it, the trees after a certain time showing no appreciable increase.

The result of this management may be seen from the following actual measurements:

In 1856 a stand of oaks, then one hundred and thirty years old, under which pasturing had been practiced, was thinned out and undergrown with beech, and last winter, thirty years after the opera tion, it was cut with the following results per acre:

(*a*) Principal growth: Forty-five oaks, with an average height of 68 feet, yield ing 3,320 cubic feet of solid wood, of which 2,082 cubic feet or 64 per cent. were over 6 inches in diameter, fit for lumber or ties; the balance represents 13¼ cords of fire-wood, of which 45 per cent. was split wood. In addition, 11 cords of inferior brush-wood were utilized.

(*b*) The undergrowth of course yielded only fire-wood, altogether at the rate of 14 cords per acre, of which only 20 per cent. was better class of wood. The total yield of wood per acre being therefore 4,765 cubic feet solid.

Measurements of average trees were then made at the height of 1 meter, 3 meters, 5 meters, and 6 meters with regard to accretion, and the average increase in the area of the transverse cut expressed in per cent. was found as follows:

Decade.	Average increase in area of transverse cut.	Movement of mass accretion.
	Per cent.	*Per cent.*
Before undergrowing:		
First	1.11	1.
Second	1.02	.98
After undergrowing:		
First	1.82	1.82
Second	1.78	1.44
Third	1.58	1.53

Now, as the total cross-section area, that is, the sum of the cross-section areas of the 45 oaks upon an acre, was found to be in the average 380 square feet, the absolute increase of this area in square feet during each decade was as follows:

	Per cent.
Before undergrowing:	
First decade	4.22
Second decade	3.88
After undergrowing:	
First decade	6.92
Second decade	6.76
Third decade	6.49

Similarly, of the 3,320 cubic feet of wood found at the time of cutting, the following masses in cubic feet are to be credited to each decade:

	Cubic feet.
Before undergrowing:	
First decade	33.20
Second decade	32.54
After undergrowing:	
First decade	60.42
Second decade	47.81
Third decade	50.80

That is to say, as a consequence of the undergrowing there was visible a decided increase of wood production—2.70 square feet in cross-section area and 27.22 cubic feet in mass; but this increased production was kept up during thirty years, so that the third decade furnished still 1.78 square feet and 17.6 cubic feet more than the decade before the undergrowing.

Other lines of inquiry under this head are, comparisons of the growth of trees in the open and in the dense forest; determinations of the yield of different growths; influence of tapping on pine growth; influence of pruning; influence of different factors of site on number, appearance, and development of trees; influence of different methods of afforestation on the yield, etc.

B.—Experiments in the nursery or field.

The nursery experiments would include all investigations which pertain to the establishment of sound rules in regard to the manner of growing seedlings of the various species.

There is, no doubt, considerable knowledge in this respect to be gathered from the experience of a few nurserymen in this country who have made the growing of forest-tree seedlings a business. But this experience is not recorded nor systematized, and even if it were, and we had access to it, it would be found that the results are not comparable, because the experiments were not carried on under similar methods, nor with a determinable object in view. As in all exact experiments, so in those as to the best methods of growing seedlings, it is of importance to isolate the various influences in order to come to a rational judgment as to the precise influence of any one condition. The comparability of experiments makes them valuable; therefore, to make them comparable the methods employed must be the same or in principle similar for all experiments.

The space allotted to this report will not allow us to enter more specifically into the consideration of the experiments under this head. The object of the experiment should be to ascertain:

(1) The expenditure in material, work, time, and money for various methods of cultivation according to site, species, and local conditions.

(2) The result or success of the methods employed, as regards certainty, expeditiousness, and completeness compared with the ex-

penditure, and considering the nature of each species in its capacity of closing up crowns and shading the ground, resistance to outer influences, rapidity of development in mixed and pure plantations.

(3) The working capacity of various tools and machines for special purposes and special localities. Such experiments must be measurable and comparable, and therefore must be made on sufficiently large areas and through long enough time. They must be conducted on a uniform, well-devised plan, and the most minute description of all conditions must be recorded.

The following interesting experiment shows the influence of weight of seed on the quality of the plant material, the heavier seed producing a superior material:

From three samples of Norway spruce seed seedlings were grown in a box under precisely the same conditions and compared when one year old. The first two samples were from Tyrol, one (*a*) containing 47,270 seeds, the other (*b*) 70,000 seeds; third (*c*) from Sweden containing 70,000 seeds to the pound.

Sample *a* showed, for any 24 plants, a weight of 2.165 grams (1,000 plants, 3.3 ounces), a volume of 2.8 cubic centimeters (100 plants, 7.1 cubic inches); total average length of plants, 14.15 centimeters (5.6 inches); length of root, 10 cubic centimeters (3.9 inches), and of the plants raised 53.5 per cent. showed vitality.

Sample *b* showed weight, 1,745 grains (1,000 plants, 2.6 ounces); volume, 2 cubic centimeters; average length of plant, 13 centimeters (5.1 inches); length of root 9.1 centimeters (3.6 inches); vitality, 45 per cent.

Sample *c* not weighed; volume, 1.5 cubic centimeters (100 plants, 3.8 cubic inches); total length, 10 centimeters (3.9 inches); root, 6.55 centimeters (2.0 inches); vitality 42 per cent. (Cf. F., Apr., 87.)

Another experiment to determine the influence of the quantity of seed upon the result, made with Scotch pine, showed as follows:

Seed per square rod (ounces)	3.3	2.8	2.3	1.8
Number of available plants	6,470	5,450	3,936	3,875
Weight of 1,000 plants	2.86	2.9	3.8	3.8

The quantity of useful material, therefore, was in proportion to the quantity of seed, but the quality as expressed by weight, showing stouter plants, was in favor of moderately dense sowing.

An experiment to determine the influence of the time of sowing lately made with Scotch pine in Germany yielded the following results, the results referring to the spring following the sowing:

The deductions to be made from this experiment are, that earlier sowing yielded altogether the best results, and that (1) germination takes place sooner when the weather is warmer, (2) the greatest number of available plants are furnished by the April sowings, (3) the greatest loss of material comes from late sowings, (4) the late sowing yields lighter material. These results are, however, applicable only to Scotch pine and for the locality, soil, climate and season in which made, and do not allow of generalization. (Cf. F. and Z., Jan., 1887.)

No. of experiment.	Date of sowing.	Days of germination to produce a full stand.	No. of plants on square rod.	No. of plants available.	Percentage of useful material.	Weight of 1,000 available plants.	Average length of root.
						Ounces.	*Inches.*
1	Mar. 27	35	21,000	19,683	**93.7**	5.8	10.
2	Apr. 3	36	19,481	16,875	86.6	5.0	10.
3	Apr. 10	32	17,507	13,567	80.6	**5.4**	**11.**
4	Apr. 17	26	**30,537**	**26,110**	85.5	4.3	**11.**
5	Apr. 24	20	18,874	13,384	70.9	4.4	10.
6	May 1	18	14,016	7,337	52.4	3.5	9.
7	May 8	18	10,930	5,970	54.6	3.6	8.
8	May 15	**15**	10,626	6,400	60.2	2.4	8.
9	May 22	18	9,867	.....	.0	2.5	8.

A very elaborate essay on the cost of forest planting in Germany Government forests states that during the five years (1880–'84) the

xpenditures for this part of the forest administration over a total orest area of 10,039,668 acres has been at the rate of 9.6 cents per cre and in all Germany the annual expenditure for forest planting nay be placed at round $4,500,000. This expenditure equals 4.7 to .9 per cent. of the total expense of forest administration and is said o represent the wages for six to eight million working days,* earned by 150,000 to 200,000 persons of the poorer population. Of this sum 0 to 50 per cent. are expended for forest planting, 25 to 33 per cent. or nursery work, the balance for forest sowing. Comparing the ost of sowing and planting with Scotch pine, for example, the fol-owing calculation is made:

Seed, 7 pounds, at 35.5 cents	$2.49
Work, preparing soil and sowing	2.41
After two years filling out with 800 plants	1.00
	5.90
Plants, 4,800, at 24 cents per 1,000	1.15
Work, planting on unprepared soil	4.60
Filling out with 400 plants	.50
	6.25

This would show that where no special preparation of the soil for planting is necessary, the first cost of sowing and planting is nearly he same. In Saxony, during five years (1882–'86) the actual cost of pine sowings was $2.80, plantings $3.19, per acre.

The cost of producing the plant material amounts to from 52 to 73 per cent. of the total cost of planting when large areas are taken nto account; that the amount changes in inverse ratio to the size of he contiguous planted area is self-evident.

In calculating the production of plant material the price per pound of seed is not always determining, since not only the number of seeds but also the germinating power of the same differs consid-erably. The latter is considered satisfactory at 40 to 70 per cent. for white pine, 30 to 50 per cent. for fir, 60 to 80 per cent. for Scotch pine and spruce, 50 to 70 per cent. for oak and maple, 60 to 70 per cent. for ash.

From the elaborate tables, showing each item of expenditure, the following calculations are here given, as exhibiting to some degree a comparative view of some interesting differences in the cost of growing seedlings of different kinds:

	Average cost.	Seeds germinating.	Seedlings harvested.	Cost of growing per 1,000.		Loss in transplanting.	Average number transplanted seedlings.	
	Per pound.			One-year seedlings in the ground.	Transplanted.			
	Cents.			*Cents.*	*Cents.*	*Per cent.*	*On sq. rod.*	*Per lb.*
Spruce	13	45,000	1,500 to 13,500	13.8 to 2.1	1135 to 54	5 to 20	1,500	8,500
Scotch pine	35½	50,000	2,700 to 9,000	32.8 to 5.7	‡100 to 11	5 to 10	1,500	550
Fir	3⅞	3,700	225 to 1,350	61 to 4.8	†230 to 52	5 to 20	1,500	850
Oak	2½	130	70 to 115	135 to 43.8	283 to 113	4 to 8	1,000	85
Ash	2½	4,500	550 to 900	142 to 46.4	286 to 121	5 to 8	1,000	680
Maple	4⅞	2,600	450 to 900	118 to 29.5	265 to 102	5 to 10	1,000	635

*In western Germany 40 to 45 cents is paid for such work for man's labor, 25 to 30 cents for woman's labor (light work). These prices, considering the difference of purchasing power of the money, correspond to about double those amounts here.
†Four years old.
‡Three years old.

The prices for seed represent only the cost of collecting and pr paring in the Government forests, and the cost of seedlings is co puted without any regard to profits, which, considering the risk a uncertainty of market and season, can not be reckoned less than to 50 per cent.

The trade prices consequently have been about as follows duri the last five years:

Seed.	Per pound.	Seedlings per 1,000.	Remarks.
Spruce	8.6 to 27 cents	$0.40	2 years old.
		1.55	4 years old (transplanted)
Scotch pine	31 to 40 cents	.30	Yearlings.
White pine	65 cents to $1.08		
Fir	2.2 to 3.3 cents	.60	Do.
Oak	1.8 to 3.3 cents	1.00	Do.
		4.90	3 years old (transplanted)
Ash	1.8 to 3.3 cents	.42	Yearlings.
		2.85	3 years old (transplanted)
Maple	3.3 to 6.6 cents	1.20	Yearlings.
		4.20	3 years old (transplanted)

That our nurserymen can not as yet furnish seedlings at prices a proximating these is probably due much less to the difference in co of labor, etc., than to the difficulty of obtaining seed, the absolu uncertainty of the demand, and some climatic differences, which see to make the growing of conifers at least much more expensive.

If our people would form the habit of ordering their supplies plant material in season, before the collecting of seeds begins, sa before August 1, the nurseryman would be enabled to form an ide of the demand and could give his customers the benefit of this ce tainty by a reduced price of 25 to 30 per cent., which he now mu charge for risk and waste and increased cost of stock on hand.

In the above statements the great difference in the cost of conife ous and deciduous plants is especially noticeable. This is due to th smaller number of plants which can be got from a pound of seed of the latter and the larger room they need in the nursery.

As the seedling enlarges in volume five to ten times in one to tw years, when transplanting in the nursery five to ten times the roo is necessary, and the cost of 4-year transplanted to 2-year not trans planted material stands in proportion, five to one or even ten to on Nevertheless, the advantage of using the more expensive transplante material, which is more easily handled, surer to grow, and stouter i growth, is exhibited in the following calculation:

For 1 acre (4,500 plants, Norway spruce).	With 4-year old trans-planted.	With 4-year-old not trans planted
Cost of plant material	$4.86	$1.3
Transplanting to forest	6.48	8.6
Filling of fail places	*1.12	†2.9
Loss of accretion at $3.24 per year	‡6.48	§12.9
	18.94	25.8

* 10 per cent. † 30 per cent. ‡ Two years. § Four years.

The difference of labor in taking up and transplanting materia which was not transplanted in the nursery as against material s transplanted may occasion a difference in cost of 40 to 60 per cent. in favor of the transplanted material.

In connection with the above calculations of the cost of growing seedlings, it is stated that as the cost of seed is in most cases the least and the cost of maintenance the greatest expense, the sowing should be tolerably thick, thus 1 pound of spruce and pine, ash and maple to the square rod, in drills of 3 inches distance, is recommended.

For transplanting in the nursery an improved machine (Hacker's) has lately been brought into use, by which, under favorable soil conditions, according to the width of transplanting, one man with two boys (or women) can transplant from 1,200 to 3,000 plants per hour.

Trial plantations.

There should be also undertaken at once by the Experiment Stations systematic trial plantations with exotic trees and such as are not native to the locality but promise more or less success. These plantings need not be extensive as to area or number of plants, as long as a sufficient number are planted under sufficiently diverse conditions to allow an opinion of their capacity for acclimatization in the locality. The results of these plantations may not be of account until after many decades, but to arrive at the result it is necessary to do the work now. The trial plantations of our White Pine (*Pinus Strobus*) made in Germany nearly one hundred years ago, show now the desirability of introducing the tree on a larger scale. As regards the objects of such acclimatization, I have stated in last year's report that it is desirable to find out whether a timber can be grown which furnishes (1) a better wood for special purposes than the native; (2) a larger quantity of wood in shorter time; (3) some particular value as nurse or in utilizing the soil or climatic conditions. The adaptability of timber-trees to our treeless plains is of course a question of prime importance, for there the native flora is deficient in economically valuable growth from which to choose. Such adaptability can only be positively asserted or denied upon actual trial under various conditions, and no simple opinion should prevail. By inference it would neither have appeared likely that the Black Alder, a tree from the wet meadows of Europe, nor the Bald Cypress from the Southern swamps of the United States would be capable of thriving on the Western prairies, yet both have succeeded remarkably on high land.

The desirability of introducing foreign trees has been a subject of lively discussion. As usual the contending parties in the prejudice of their individual opinions are too one-sided to be right. It would be neither advisable to rely entirely upon trees not indigenous to the locality, nor to discard them altogether and in all conditions everywhere, and to discourage their use for trial or for special purposes for which they have proved themselves adapted, as for instance the Scotch Pine and Norway Spruce for wind-breaks in Iowa and Illinois.

In planting to forest it would be prudent probably to give preponderance to a native species, mixing in such exotics as may appear desirable in single individuals, or at least never to a greater proportion than 50 per cent. The use of European species, which until lately has been so prevalent, was probably due to the fact that nurserymen could procure such supplies most cheaply and conveniently. Until a few years ago even our native White Pine seed was for nursery use imported from Germany, and almost all seed of the Black Locust, a native of our West Virginia mountains, is still brought from France. The ease of obtaining material has more to do with the introduction of European species than their superior value. Meanwhile our na-

tive species and the extension of their field of distribution have been neglected. We would advise, therefore, that experiment stations interest themselves assiduously in the recognition of the value of our native species for various purposes and localities. And here the question of the influence of the locality from which the seed or plant material is procured needs attention. Some of those species which appear desirable objects of forest planting and capable of a wide extension in their use are enumerated, with notes of what is known of them, further on.

C.—Experiments in the laboratory.

These would include, besides the work required for the establishment of timber physics, as outlined above, being the most important direction in which work should be done at present, such investigations as these:

Germinating power of seeds and means of its preservation; influence of temperature and depth of cover on time of germinating; influence of mineral composition of the soil on quantity and quality of wood production; investigation into the composition and rapidity of conversion into humus of leaves from different species, etc.

D.—Phenological and meteorological observations.

These should be undertaken simultaneously and under a uniform plan by all Stations.

The periodical phenomena in the development of plant life, as the budding and the fall of leaves, the development of flowers, the ripening of fruit, etc., are dependent on the harmonious co-operation of the factors of climate. They are, so to speak, indices of the total effect of climatic changes, which depend on temperature, moisture, cloudiness, etc.

The object of phenological observations is obviously then to study the influence of climate on the development of plants, and the value of continued systematical observations can be easily inferred.

The following considerations should be kept in mind in these observations:

(*a*) Choice of locality and plants:

(1) Not too far from the house of the observer one or more places should be chosen which contain as many different species in their natural habitat as possible. In the period of rapid development, when the leaves or flowers are ready to open, for instance, a daily visit is required.

(2) Each place of observation should contain as much as possible the same configuration and exposure, so that the plants on the same are subject to the same climatic and local influences. It is best to select a level place, not too much exposed to wind and not too near to a mountain-side or houses, so that an unimpeded influence of light, temperature, and atmospheric moisture is secured.

(3) In mountainous districts the plants to be compared should all be on the same exposure, and the exposure must be noted.

(4) Choose trees fully developed, yet not too old, and capable of flowering.

(5) Choose trees in free position and fully exposed to the sun.

(6) Some trees develop especially early or especially late, like the Soft Maple and others. These are not desirable objects of observation.

(7) Observation of the same species on different exposures will enhance the work.

(8) The observations must be made on the same individuals every year.

(9) To get average results the observations should be continued for several years.

(10) A few species observed with exactness will yield better data than too many slighted.

When exact meteorological observations are not systematically made it is desirable to add a meteorological record.

Every plant requires for its full development a given quantity of warmth during the time of vegetation and can develop perfectly only in sites where this sum of temperatures occurs during the season.

Thus the minimum of total heat quantity above freezing point during the period of vegetation which the Norway Spruce requires for its normal development amounts to about 2600° F., corresponding to the isotherm 35° F., as its northern limit of distribution, with a maximum summer temperature of 66° F. For the European Larch it is claimed that a minimum heat quantity of 3000° F. is required, corresponding to the isotherm 37° as its northern limit; the extremes have not been determined, but it is in general known that the larch can endure low winter temperatures, but not high summer temperatures; it requires a short spring quickly following a uniform moderately warm summer and long winter rest for perfect development. It stands to reason, however, that other atmospheric conditions must modify to some extent this factor of vegetation. The exact measurements for the determination of these temperature sums must be left to skillful hands, with proper instruments; but other meteorological data can be readily noted by the lay observer, especially the first and last snow-fall, number of days below freezing point, days of early frosts in fall and late frosts in spring, number of days of snow-fall and of snow covering the ground, date of melting snow in the forest (not in depressions), number of days of thaw, of rain, of mist, days of cloudy, half cloudy sky (to denote the influence of light), clear days, days of thunder, storm, hail, beginning and end of seasons.

As a frosty day should be noted every day on which frost occurred (day or night); a snowy day, every day on which any snow fell; the same idea prevails for rainy days; a clear day is one on which the sky has been clear most of the day; a cloudy day, one on which the sky has been all day entirely or mostly covered; half cloudy, one on which the sky has been partly cloudy and partly clear.

A comparison of the results of such meteorological observations with the phenological observations will bring important and interesting results in regard to the influence of climate on vegetation. Such observations do not require much work, but if continued for several years will have served a good purpose and benefitted the observer as well as science. If even, as is claimed by some writers, the scientific value of these observations is less than it appears, their educational value can not be doubted.

When, therefore, the writer, in the spring of 1886, on assuming the duties of this office, and again in 1887, sent out schedules for phenological and meteorological observations a special effort was made to interest the agricultural colleges and other institutions where botany is a study, as it appeared an excellent aid for the students of botany, stimulating them to regular and close observation. With the exception of the university at Ann Arbor, however, no returns could be obtained from the agricultural colleges. Professor Spalding, of Michigan University, at Ann Arbor, systematically directed his students in this work, and the results have been satisfactory to teacher and students alike. It is to be regretted that the very institutions which are expected to encourage the study of forestry and which have their professors of forestry and students of botany, should be slow in making use of such an aid to practical study, which at the same time, by co-operation, promises results of value

The schedules returned do not contain sufficient material to enable us to compile a comparative table for the United States during last year; we have therefore to content ourselves with the following tabulation of the observations made at Ann Arbor by the students of botany under Professor Spalding's supervision, kindly transmitted by him. It should be understood that the occurrence as well as the observation of the occurrence of any one phenomenon may vary with different individuals; therefore a range of dates, rather than one date, is given.

Phenological observations at Ann Arbor, Mich., 1887.

Names.	Opening buds.	Mature leaves.	Full flower.	Full foliage.
Horse Chestnut	Apr. 20 to 24	May 5 to 14	May 5 to 10	May 10 to 20.
Red Maple	Apr. 17 to 24	May 5 to 15	Apr. 17 to 21	May 12 to 20.
Silver Maple	Apr. 21 to 24	Apr. 21 to May 15.	Apr. 17 to May 25.	May 8 to 15.
Sugar Maple	Apr. 20 to 24	May 5 to 10	Apr. 22 to 28	May 8 to 12.
Tulip tree	Apr. 21 to 28	May 10 to 20	May 22 to 29	May 20 to 26.
Basswood	Apr. 24 to 28	May 15 to 19		May 22 to 28.
American Elm	Apr. 18 to 24	Apr. 30 to May 19.	Apr. 17 to 21	May 15 to 22.
Red Elm		May 20 to 24	Apr. 21 to 25	May 27 to June 8.
Slippery Elm	Apr. 27	May 15 to 20	Apr. 21 to 24	May 28 to 30.
White Ash	Apr. 24 to 28	May 20 to 25	Apr. 20 to 21	May 22 to June 1.
Black Walnut	Apr. 24	May 28 to 30	May 15	May 28 to 30.
Black Locust	Apr. 27 to 30	May 20 to 22	May 20 to 22	June 1 to 4.
White Oak	Apr. 30 to May 5	May 18 to 22	Apr. 28 to May 10.	May 22 to 30.
Black Oak	Apr. 28 to May 5	May 5 to 19	Apr. 24 to 28	May 23 to 29.
Burr Oak	do	May 15 to 22	Apr. 28 to May 15.	May 29 to June 8.
Black Cherry	Apr. 20 to 25	May 8 to 19	May 15 to 22	May 20 to 30.
Shag-bark Hickory	Apr. 23 to 29	May 19 to 29	May 8 to 25	May 24 to June 12.
Catalpa*	Apr. 26 to May 22.	May 19 to June 12.	May 29 to June 12.	May 25 to June 13.

* Probably *C. speciosa.* The dates here given are the prevalent ones noted by observers for *C. speciosa* and *bignonioides.*

E.—Forest climatic observations.

The mind of the public has been considerably agitated with wild theories on forest climatic influences, upon the ground of which forest protection and forest preservation are asked. Some have run wild in one direction, claiming indiscriminately and without proper basis most potent influences; others have misused and misconstrued existing meteorological observations to prove the non-existence of such influences. Those who have less interest in the proving or disproving of theories than in the establishment of scientific truth admit that upon the basis of exact experiments—not opinions or theoretical reasonings—the influences as outlined in my last year's report (p. 151 f f) are proved and their character ascertained. The degree of influence, its extent and therefore practical value, remains still an open question, and probably can be satisfactorily settled only by continued direct and special investigations.

The institution of forest-meteorological double stations in connection with each Agricultural Experiment Station is therefore highly desirable. The cost of a complete outfit of instruments needed for such forest meteorological stations was some time ago estimated, in the hope that the Forestry Division might be able to undertake such observations in co-operation with the Agricultural Colleges, as follows:

1 barometer	$13
3 thermometers (for field, forest, tree tops), at $2 (if self-recording more expensive)	6
2 maximum and minimum thermometers, at $10	20
1 maximum or solar radiation thermometer	5
12 soil thermometers, average, $5	60

rain gauges, at $10	$20
snow gauges, at $2.50	10
psychrometers or hygrometers (hygrodikes), at $15	30
Lamont's atmometers, at $6	12
evaporation apparatus, at $3	6
lysimeters for 1 foot (percolation), at $2	6
lysimeters for 2 feet, at $4	12
lysimeters for 4 feet, at $6	18
anemometer	20
Total	238

The observations at such stations will have to be directed to a comparison:

(1) Of the temperature of the atmosphere within the forest and over the open field.

(2) Of the temperatures at 5 feet from the ground and at the tree tops.

(3) Of the humidity of the air within the forest and without.

(4) Of the evaporation under forest cover and on the open field.

(5) Of the quantity of rain and snow which reaches the soil in the forest and in the field.

(6) Of the temperature of the forest soil at various depths (at 0 foot, at ½, 1, 2, 3, 4 feet) and that at the same depths in the open field.

That the other usually noted meteorological data should be observed at the same time is obvious.

The greatest difficulty will be to find appropriate locations for the instruments and to guard them; and further to find reliable and accurate observers, for the observation of the instruments set out at a distance from the house of the observer is coupled with greater hardships than that of the ordinary set of meteorological instruments, and is likely to become a discouraging task apt to be neglected.

The climatic influence of the forest in vertical direction, *i. e.*, its influence upon the condition of air strata above the forest, has been by most writers entirely overlooked and a measurement of the influence upon the next surrounding locality in horizontal directions has been mainly attempted, yet it is most likely that a large forest area exerts a much more powerful influence upon atmospheric conditions vertically than horizontally. It is, for instance, most likely that the existence of even a small forest area or grove of high timber will lessen the danger of cyclones, because disturbing or preventing the cause of their formation, which presupposes a layer of overheated air overlaid by a layer of colder air temporarily without exchange.

TREE NOTES.

While we would advise forest growers in most cases to plant rather than sow, and to secure their material from reliable nurserymen in preference to growing their own seedlings (for it would in the end be the cheaper plan), for a limited supply of a few specialties the method of growing seedlings described by Mr. Jackson Dawson, of the Arnold Arboretum, at Boston, as the "box system" may recommend itself to the layman. I copy, therefore, as nearly as possible, the description of this method of procuring seedlings as it is given by this skillful propagator.

"Procure a lot of common boxes such as may be had at any grocery store. kind of boxes will do, though a uniform size is best, as they occupy less space 6-foot frame, when packed away, than boxes of various sizes would. I usuall those that have contained canned goods or soap, as they are nearly equal in and with two cuts of a splitting saw you have from each box three flats fr to 4 inches deep, which is a good depth for any ordinary seed. With a half- auger bore three or four holes in the bottom of each box for drainage. This be sufficient for large-rooted plants, while the finer seeds will require to be drained with broken pots, coarse siftings of peat, or any coarse material that allow the moisture to pass off readily. As soon as the seeds are ripe in the fall together a good pile of compost, made as follows: Two parts of rotten sod, one peat, and one of sand, and if the seeds to be sown are oak, hickory, beech, chest or walnut add a portion of good rotten manure. For such seeds as I have n tioned fill your boxes two-thirds full of the compost, and press down firmly wi board or the hand. Sow the seeds evenly and press them down in the soil, cove them from one-fourth of an inch to an inch in depth, according to their size. one corner of each box smooth off a place with a plane or knife, rub over w white lead, and write the name of the seed and the date of sowing. This takes a few minutes and is of so much value afterwards, especially where a great var of seeds is sown. After sowing the seeds should have a good watering with a hose to settle the soil. The boxes can then be piled four or five deep in a pit, sashes placed in, and at the approach of cold weather they may be covered w meadow hay or leaves. This does not keep the boxes from freezing, but when o frozen it keeps them so until spring. If no pit is available the boxes can be pi six or seven deep in a well-sheltered spot, covering the upper boxes with a boards, the whole to be covered with leaves or other litter. As soon as the weat is settled, which is usually about the middle of April, choose a well-sheltered sp level, and handy to water. If the aspect can be an eastern or southeastern on like it better, as they get the early morning sun, but not the scorching sun at no day. Place all the boxes containing the nuts, acorns, and other large seeds togeth in beds of three boxes wide. This will make it very compact, and much easie care for them than if the boxes containing seeds of the same class are scatte about. The only attention these will require is to keep them well watered and f from weeds; but for such seeds as maple, ash, and others of like nature, it wou be well to cover the boxes with lath screens until they have made the second third rough leaf, when they might be gradually hardened off, and finally exposed fu to air and light. The same for conifer seeds. If a few sashes could be spread protect all delicate growing seeds it would be of great advantage, and as soon well up they could be treated the same as the others.

"The use of lath screens on seed-beds saves a great amount of labor in waterir and if the plants are neglected for an hour or so the results are not so disastrous when the young seedlings are fully exposed to the sun. Any boxes of seeds th do not come up before the last of June will hardly appear that year, but will quire to be kept moist, the same as the growing plants. I usually place all su boxes together in a shady spot and cover them to the depth of an inch or more wi sphagnum, and by giving them a good watering once or twice a week they are c ried safely through the summer. At the approach of cold weather they are gat ered together, piled five or six deep as before, and covered for the winter. Wh spring comes on they will need to be treated as seed that has just been sown.

"In the fall of the first year the boxes of young trees may be gathered togeth and wintered in a deep pit or frame and slightly covered with meadow hay. If frame is available, 3 or 4 inches of pine needles or leaves may be placed over t boxes, and they may be left until spring; but on no account should the boxes left without any protection, as the young seedlings will then suffer very much so little depth of soil.

"All seedling trees can be transplanted when very young as easily as cabbages tomatoes if taken as good care of; and many of them are benefited by the opera tion. We transplant thousands of them every year with little loss. The best tim is when they are making their first or second rough leaf.

"In the spring of the second year all the young seedlings should be transplante from the seed-boxes to the nursery beds, or the larger ones planted where they ar to remain; and for chestnuts, hickories, and oaks I believe it is best to plant ther from the seed-box to the field where they are to remain.

"The boxes I have mentioned are usually from 14 to 16 inches square, and wi hold from 100 to 125 oaks, hickories, chestnuts, or beeches; 175 to 200 ashes o maples; 250 birches or elms; and so on according to the growth of the plants."

From the same authority we may be allowed to quote the directions for treating conifer seeds, which, with the necessary modifications, will hold as well with use of the box system:

"The ground for these seeds should be a light, rich loam, deep and well pulverized, or, if not rich, made so with a good dressing of well-decomposed manure. The beds should be laid off 5 feet wide and the alleys 3 feet. Along both sides of the beds, at intervals of 5 or 6 feet, drive a row of small posts that will rise 6 or 8 inches above the surface of the beds. The beds should be a few inches higher than the paths, so that the water will not stand on them. The situation should be as sheltered as possible both from the midday sun and from drying winds; the north or east side of a hedge or fence is a favorable position. The beds being all prepared and raked very fine, as soon as the weather becomes settled—say from the 10th to the 20th of May—the seed may be sown thinly, in rows 6 inches apart across the beds, or broadcast, and slightly covered, certainly not more than twice their own diameter. The sowing in rows is most convenient in working them, both in the way of keeping the beds clean and stirring the soil among the young plants. I would here say that all seeds sown during warm, dry weather are much benefited by having the ground lightly rolled over them. The sowing being completed, place on the posts before mentioned lath screens, made the width of the bed, with the laths not more than an inch apart. This will screen the plants from the sun and in part protect them from the birds, which often pick up the young seedlings that are just breaking ground. If no laths are handy the seed-beds can be covered with pine, cedar, or hemlock branches, quite thickly at first; but the beds must be watched carefully, and as soon as the young plants begin to appear the branches should be gradually removed, until only enough are left to slightly shade the young plants, and these should be raised some inches above the plants. It is a good plan where pine needles are plenty to cover the seed-bed thinly between the rows with them. This keeps down the weeds, saves much watering, and keeps the soil from washing or baking. If the ground is very dry at the time of sowing they will require a slight watering; otherwise they will not need it. In my experience there are few seeds that require so little water as those of conifers during germination.

"The critical time with young conifers is the first three months of their existence, until they have made the crown bud. After that time there is very little danger, but until then extreme watchfulness is very necessary. A great quantity of rain or a scorching sun will often prove fatal to thousands. Stirring the soil after heavy rains, and tilting the screens as soon as the sun is gone from them, or sifting dry soil amongst the beds of overwet seedlings is of great benefit. After the muggy weather of August is past they will require very little care the rest of the year. At the approach of cold weather they are best protected by a slight covering between the rows, and a few pine branches or a little meadow hay spread over the tops of the young plants will keep them in good condition until spring."

The following notes on some of the trees, the seed of which has been distributed from the Department during the season, have been compiled from various sources, in order to give an idea of their value and the mode of their propagation. It will be noticed that the majority are native conifers. Several reasons have led to their employment in distributing trial packages of seed. Aside from their eminent value for forest planting, the seeds of coniferous trees can be more easily kept and in general are less liable to deterioration than those of most of the deciduous trees; seed remaining over is therefore not entirely lost.*

Furthermore, the difficulty of raising evergreen trees deters our inexperienced forest planters from using the same. The encouragement, therefore, of furnishing free of expense the seed for trial (and with the funds at disposal no other substantial aid could be expected) seemed to be the most legitimate interpretation of the purpose of the law. I refer to page 35 of this report on this subject.

* The seed of willows loses its power of germination in five or six days; poplar and elm seeds may not be kept over winter, acorns, beech-nuts, maple, and fir may be kept for one winter under precautions only; the seed of pine (Scotch and White Pine at least) may be kept in germinating power three years and more, spruce and larch from one to two years longer. Scotch Pine seed two years old still germinated 60 per cent., and when five years old, 32 per cent.

1. WHITE PINE. (Weymouth Pine. *Pinus strobus*, Linn.)

Distribution.—Northeastern Minnesota and southeastward along the Mississ to eastern Iowa, and eastward through the Northern States to the Atlantic; sou ward from Pennsylvania along the Alleghany Mountains to northern Georgia; nc of the United States boundary to latitude 52° on the west, and to about latitude on the east. In some parts of its range this pine forms (or once did) immense f ests of pure growth; while in others it is more or less scattered and associated w other pines (*Pinus resinosa*) and hard-wood trees, especially in the Great Lake gion.

In 1705 it was extensively introduced into England, and to a limited extent i France at about the same time, somewhat later becoming generally known on t Continent as an ornamental tree, and tried as a forest tree in Germany to some tent.

Growth.—The White Pine is a long-lived, hardy, vigorous, and rapid grower, ceptional trees being found indicating an age of four hundred years. The first fi years are marked by slow growth, during this time making an average annu height-growth of only about 2½ inches. The period of rapid growth begins about five years and continues up to sixty years, the average annual height-grow during this time being about 2 feet, and in diameter from ¼ to ⅓ of an inch. commonly reaches 100 to 150 feet, with a diameter of 3 to 4 feet; exceptionally c trees, though, have been cut 200 feet in height and 6 to 8 feet in diameter. T White Pine is remarkable for the large production of timber per acre.

Soil and Site.—The White Pine grows naturally and best in a cool climate on a mois light, deep, and sandy soil, with porous subsoil; when in forests of pure growt usually on such soils as are agriculturally of little use after the timber is remove where it occurs with hard-wood timber, the soil is of a richer and better quality. Bu it is very adaptive to other dry and moist soils (not pure sand); in fact, maintainii itself fairly well in heavy clay soils not too constantly wet. In a warm climate northern exposure will almost always be the most favorable situation. Being mor or less closely associated throughout much of its range with the Red Pine, it is ver like this species in its demands upon soil conditions. It will endure windy and col positions, though little tolerant of drought unless the soil is sheltered by othe shady companions, and therefore best mixed with deciduous or other conifers, a lowing considerable light and room for its crown, as it will bear but little shadin from above. With this pine, as is undoubtedly true of all conifers, the kind an condition of the soil has much to do with the quality and relative value of th timber. In general a loose, deep, moist soil of the plain produces a type of timbe combining all the highly excellent qualities of the species; while grown in elevate situations in a soil that is dry and compact, the timber is usually less desirable.

*Propagation.**—The seed is easily obtained and seedlings readily grown, pur suing the same plan as with the Red Pine (No, 2).

Seedlings come rather slowly and irregularly, but if the seed be perfectly fresh a large percentage germinates.

Quality of Wood and Economic Uses.—The wood is generally soft, free from resin straight-grained, and easy to work, but not very durable unless protected from moisture. It is more extensively manufactured into shingles, various kinds of lumber and building timber, and more generally used than other North American timber tree. Originally this pine was used considerably for mast timber, and large trees especially protected for this purpose by the English in their possessions in this country prior to 1812.

Timber of this species grown in Europe and cut for uses at an age less than fifty years—a time at which the wood is immature and not at its best for economic purposes—led these consumers to wrongly consider it inferior to their native Scotch Pine. Their error in cutting too soon is, however, better understood, as it is now evident that at least eighty to one hundred years is required to produce the best quality of White Pine, leading them to begin an extensive cultivation at an early date.

Descriptive Characters.—Leaves five in a sheath, slender, soft, more or less glaucous, usually 3 to 4 inches long, persistent about two years. Cones one to three in a cluster, 4 to 6 inches long, drooping or bent down at maturity (two years) and curved; rather slender, cylindrical, of a light brownish color; the scales are long and narrow, except at the tip, where they are thickened and broader, smooth, and without prickles: seed with wing $\frac{8}{10}$ to $\frac{9}{10}$ of an inch long; the wing with numerous stripes and from $\frac{1}{5}$ to $\frac{1}{4}$ of an inch wide; the ripe seeds are from $\frac{1}{4}$ to $\frac{3}{10}$ of an inch long by $\frac{3}{20}$ of an inch wide and $\frac{1}{10}$ of an inch thick; light brown mottled with darker irregular markings or entirely overspread with the latter.

*See table on page 95.

The foliage of this pine is comparatively thin and delicate in its general aspect, d the bark of trees up to about twenty to twenty-five years old smooth; later it comes rough and furrowed. Trees grown in the forest have remarkably straight nks of uniform diameter and free from side branches, the latter then being ort and the crown small and contracted. In the open it has a large, somewhat nical-shaped crown, the branches reaching to the ground.

2. Red Pine. (Norway Pine. *Pinus resinosa*, Solander.)

Distribution.—From Minnesota eastward through northern parts of Minnesota, isconsin, Michigan, and Pennsylvania, to the Atlantic, and north of the United ates boundary to latitude 52° on the west, and to about latitude 50° on the east. rarely, if ever, forms dense or extensive forests of pure growth, but is generally sociated with the White and Pitch Pine in open tracts of only a few hundred acres most. It is most abundant and best developed in the region of the Great Lakes l in the extreme northeast; rare and much scattered in its southern range. The elder Michaux first observed this pine in Canada, and in 1756 it was introced into England, where it has become quite generally known and cultivated as ornamental tree; it has not been tried in Germany or France, though would unubtedly succeed in the northern portions.

Growth.—The Red Pine is a vigorous and rapid grower, deserving special attenn in northern localities, where it is becoming scarce, as well as in those where it is indigenous. It is a long-lived tree and commonly attains a height of 60 to 70 t, though the best developed specimens are not unfrequently 100 feet in height, and sometimes 4 feet in diameter.

Soil and Site.—The Red Pine is very adaptive, succeeding in almost any soil from to moist suitable for conifers, but it prefers and grows naturally in a light, well-ined, sandy soil, where the best size and quality of timber is produced. Though urally a tree of the plain, it is perhaps the hardiest of our native conifers and may expected to succeed on slopes of moderate elevation, but preferably on a north- exposure, especially in latitudes south of Pennsylvania. It endures drought and l well, but like all pines will bear only slight shading.

Propagation.—The seed of this pine is expensive and difficult to obtain true to me. The consumer needs to be very critical, for, unfortunately, some dealers do and have not hesitated to substitute the cheaper and more easily obtained e seeds that closely resemble those of *P. resinosa*. The following are not unmonly substituted: *Pinus rigida* (Pitch Pine), *P. inops* (Scrub Pine, *P. Banksa* (Gray Pine), *P. sylvestris* (Scotch Pine), and *P. mitis* (Shore-leaved Pine). he seed of the first four are all longer, less plump, and more or less black or sharply rked with dark areas; but that of the Gray Pine (which comes from the same localand is more easily gathered) so closely resembles the Red Pine as to almost defy ection. The Red Pine seed, however, is more generally marked with furrows, ile the Gray Pine seed are only occasionally so marked. The latter are also quite ularly and sharply marked near one end with rich brown specks. The wings, , are much shorter ($\frac{1}{2}$ to $\frac{3}{5}$ of an inch) and broader ($\frac{1}{5}$ of an inch) throughout their gth than in the Red Pine. In general the latter seed may be known by its dull clay-yellow color, and the absence of any well-pronounced marking.

Plants are quite easily grown from seed, and if the latter be perfectly fresh, a ge percentage usually germinates. It should be obtained in the fall or spring er ripening; yet a good portion of carefully kept seed two years old will grow, not readily.

ow early in spring in beds of sandy soil in a cool place, distributing the seed nly and placing over them only soil enough to cover them. The bed should shaded and kept constantly moist. Fresh seed will germinate in from ten to een days. At a distance between the rows of 3 to 6 inches apart the seedgs can remain in the seed-bed until the following spring, when they should be nsplanted in rows to a distance of about 1 foot. Allowing them slight shelter m the heat and cold for the first two years, they can be readily transplanted to manent sites at any time thereafter; but the longer they are kept and transnted in nursery rows the better they bear final transplanting. It is obvious, n, perhaps, that the lack of this treatment, together with a disregard of other cautions in taking them up, that seedlings from the native forests of the North nted in the open almost invariably die.

Quality of Wood and Economic Uses.—The wood of this pine is resinous, coarsened, harder, more durable, and stronger than that of the White Pine, with which handled in the market. It is nearly as easily worked and perfectly well adapted he same uses. It is extensively manufactured into various kinds of lumber and lding timber, and the resinous qualities render it more useful for certain pur-

poses than the White Pine. The flooring made from this species is highly esteem for its wearing qualities. Large quantities of this timber are used for deck-plan spars, and piling. The trunks of the Red Pine are remarkably uniform in diame and free from knots, "clear" sticks of timber often being obtained 40 to 60 feet lo

Descriptive Characters.—Leaves in brush-like clusters at tips of branches, two long dark sheaths, 5 to 6 inches long, and of a deep-green color. Cones mostly to 1¾ (sometimes 2) inches long, light russet-brown, conical or slightly ovate in fo scales thickened, blunt, and polished at the ends: fertile seeds borne in the mid third of the cone: they are small, ⅛ to $\frac{3}{16}$ of an inch long, very plump in appe ance, about $\frac{3}{16}$ of an inch thick; one face of the seed is more or less marked w one or two oblique furrows; the ground color is dull yellowish, with or without distinct speck or dark areas; wing nearly ¾ of an inch long, light brown, wit satiny appearance. Bark of the trunk reddish, more so than that of any ot American pine.

3. Short-leaved Pine. (Yellow Pine. Spruce Pine. *Pinus mitis*, Michx.)

Distribution.—The northern limit of its natural distribution is described by a l from southeastern New York extending diagonally through Pennsylvania, W Virginia, Kentucky, southern Illinois, and Missouri, following somewhat the 38 parallel of latitude to western Missouri; thence along the 95° of longitude in western Texas; the southern limit ranging above latitude 30° to the Chattahooch River (western Florida); thence northeastward along the Blue Mountains to Pamli Sound (North Carolina). Within this range it increases in extension by replaci the deciduous trees, when they are removed, and covering abandoned fields. often forms forests of pure growth, but in parts of its range, especially where t original growth have been cut off, it is much associated with the Loblolly a Jersey Scrub Pine, as well as often with deciduous trees, where it usually attai its largest size. Said to have been introduced into England in about 1740.

Growth.—In rich soils the average growth is considerable, annual shoots not u commonly amounting to 2 or 3 feet in height; while on poorer soils the growth rather slow, although the quality of the timber is better. Under favorable con tions a large tree, 40 to 90 feet in height and 1½ to 4 feet in diameter, the trun being tall and free from branches for a long distance.

Site and Soil.—In its natural state this pine occurs chiefly on light, sandy soil hills and valleys; also on stiff clayey but dry and rather poor soils, sometimes gro ing on the borders of swamps, and will endure even a wet, miry soil, but with po growth. The finest growths seem to be produced in a rather deep sandy or loo gravelly soil, with some admixture of clay. The examples found on dry, hard soil barren hills are short and stunted, not making more than one-third of the heigh growth peculiar to trees growing in sandy or more permeable soils. Requires co siderable light.

Propagation.—This pine is readily and easily grown from the seed. It retains i vitality for a comparatively long time, germinating quite freely when two (an possibly three) years old.

Seed may be sown rather thinly in a sandy loam bed, well shaded, and neve allowed to become dry; the covering of soil should be light, not more than on fourth of an inch. Fresh seed will germinate in from ten to fifteen days. Th seedlings can stand in the seed-bed for one year and then be moved to their perm nent sites if the soil be well prepared and additional care given for about two year Its adaptability to soil conditions and considerable climatic range recommend it fo further extension.

Quality of Wood and Economic Uses.—The wood is heavy, hard, and strong, equa ing that of the Long-leaved Pine, which it closely resembles and is handled wit in the market; the heart-wood of old trees is close-grained, quite resinous, an durable when exposed to moisture, while the sap-wood decays rapidly. Whe most abundant it is largely manufactured into lumber and building timber of variou kinds, and is especially valuable for flooring.

Descriptive Characters.—Leaves mostly 2 (sometimes 3) in a long sheath, 3 to inches long, more slender and softer than any of the associated species of pines Cones 1½ to 2 inches long, oval or somewhat conical; scales with a short, delicate incurved prickle; light brown; seeds rather small, $\frac{2}{5}$ of an inch long by $\frac{1}{10}$ to ⅛ o an inch wide, more or less with dark scattered or confluent specks; the wings ar reddish and about ½ an inch long. The young shoots are generally violet colored The bark of mature trees rather thick and broken up into squarish plates. Th different general appearance of this pine will almost always serve to quickly distin guish it from the often closely-associated Scrub Pine; any doubt can be removed b trying the twigs: those of the Scrub Pine are tough, while those of the Short-leave Pine snap off readily.

BULL PINE. YELLOW PINE. (Heavy-wooded Pine. *Pinus ponderosa*, Douglas.)

Distribution.—In British Columbia up to latitude 51°, throughout Washington erritory, Idaho, western Montana, and ranging southward in two belts: the one rough Oregon and California nearly to Mexico, the other occupying the entire ocky Mountain Region to western Texas, and reaching out to the Black Hills of akota; absent in Nevada. Very generally distributed throughout this range, in any portions with a few other conifers (mostly Douglas Spruce and *Pinus Jeffreyi*) rming extensive but usually open forests, though sometimes constituting the rincipal growth itself. Best developed in eastern California on the western slopes Sierras. Within its range its extension is increasing rapidly. It was first dis-overed by David Douglas, and by him introduced into England in 1826, where is successfully grown.

Growth.—Tolerably rapid grower, and commonly attains a height of 100 feet, ith a diameter of 2 to 3 feet, though sometimes found with a height of 250 feet nd a diameter of 10 feet.

Site and Soil.—In its natural habitat this pine seems to depend more upon certain il conditions than upon the configuration of the land, where the former are pres-nt often occurring at altitudes from a little above the sea level to those of one or vo thousand feet. It naturally seeks warm aspects with gravelly or sandy soil, he largest specimens being found where the soil is sandy, rich, deep, and well-rained. Yet it grows successfully on sites not too steep with a poor dry soil; oc-asionally it descends into rather swampy situations, though it can not be said to be home here. Although usually growing on warm sunny exposures, this species found to be very hardy, except when young, and capable of enduring dry winds nd exposures; it will, therefore, probably prove a desirable addition to the conifers r prairie planting.

In a cold climate it is best to select a rather poor soil, as in a rich one it grows too gorously, leaving shoots with immature wood liable to injury from frost. Best mixtures and requires considerable light.

Propagation.—Readily grown from the seed. It is essential to obtain perfectly esh seed, as but a small percentage germinates. It should be sown as soon as ossible; if received in the fall, early in the spring, in the meantime taking care at it does not become dried in a heated room.

Sow seed thinly in a sandy loam bed, keep evenly moist, and protect seedlings om the sun and late frost. If the seedlings stand 6 to 8 inches apart they can left in the seed-bed one year, protected from severe cold the first winter (and tter the second and third also), as this species is quite tender when very young. he second year they can be given more room in nursery rows, and are undoubt-lly best cultivated here for at least a year longer, as they will then have become ore hardy and able to maintain themselves with less care and protection.

With age this pine becomes hardy and grows rapidly even in poor soil, but it must ot be crowded or overshaded.

Quality of Wood and Economic Uses.—The wood of the natural growth is variable quality, often twisted and knotty, but usually quite heavy and coarse-grained, rd, and strong, though not generally durable, unless protected; highly resinous d used for pitch. It is the most abundant of the large pines in the Pacific region, here it is extensively employed for lumber, mining, and building timber, ties, fuel, c., and though not so easily worked as the wood of the white pines it is suitable r fine interior work, the grain being very attractive when finished.

Descriptive Characters.—Leaves 3 (sometimes 2) in a sheath, 3 to 6 inches long, ush-like at the ends of the branchlets, persistent for three years. Cones 2 to 3 ches or more long, gray-brown; scales with strong prickles. The seeds are quite rge, $\frac{3}{8}$ to $\frac{1}{2}$ an inch long, and $\frac{1}{4}$ to $\frac{3}{8}$ of an inch wide, irregularly flattened and some-hat triangle-shaped; dull light-yellow with dark specks and streaks on the con-x side, and dark-brown on the flattened side; wings brownish and about 1 inch ng. Bark very thick, on old trees often 3 to 4 inches. Crown usually small and en, the branches occurring quite regularly in whorls; the trunks often free from anches for 40 to 70 feet.

5. CALABRIAN OR CORSICAN PINE (*Pinus Laricio*, Poir., var. *Calabrica*).

[This species furnishes the Austrian Pine, *Pinus Austriaca*, Hoess, a form which differs from the esent one mainly in its geographical range and in the character of its leaves.]

Distribution.—A native of the Island of Corsica (in the Mediterranean); found also southern Italy (Calabria) and in the mountains of Greece. Introduced into Eng-nd in 1815; into France in 1819; into America only to a limited extent, being tried ainly in the Atlantic region, while the Austrian form is quite generally planted.

Growth.—Said to be superior to the Austrian Pine, and probably as rapid, more so, than the Scotch Pine, producing a serviceable timber of good qual fifty to sixty years. In its native habitat it reaches a height of from 70 to 10 with a diameter of 2 to 4 feet.

Soil and Site.—Very adaptive, accommodating itself even to a poor soil; bu on lime soils with porous subsoil. Its very strong root system promises to m especially valuable in semi-arid districts, as it prefers a dry atmosphere and is hardy. Southern exposures are most desirable, as it requires considerable he its development. It is quite capable of thriving on thin, compact, and almos penetrable soil and rock, and is therefore said to be very well adapted to sea- planting. Endures moderate shade.

Propagation.—The seed (without wing) is $\frac{1}{2}$ to $\frac{2}{3}$ of an inch long, and about $\frac{1}{8}$ inch wide, usually dark brown with more or less confluent spots and diagonal ri In size it is between those of the Cluster Pine (*Pinus pinaster*), and the Scotch (*Pinus sylvestris*); in form and general appearance much like the latter; and much dearer and more difficult to obtain than either of the other two, is mixed, especially with the Scotch Pine.

Sow rather thinly in well-prepared light loamy bed, covering with about an inch of soil; shade and keep evenly moist. After one year in the see they can be transplanted 8 to 12 inches apart in the row, where they can re a year or more, and will then be ready for final planting. They will be bett during this time, they are grown in the light shade of other trees, and banke during the winter.

Quality of Wood and Economic Uses.—The sap-wood of this species is thi perhaps than that of any other pine; but the heart-wood is quite strong, elastic, especially durable. It is considerably heavier and more elastic than the woo Scotch Pine, and the grain is rather coarse, but the wood is easily worked and adapted to the same uses as the better class of pines. In Europe the timber has been employed for ship timbers, masts, and for large building timber in genera

Descriptive Characters.—Leaves light green, mostly somewhat oppressed, 2 short sheath and from 4 to 6 inches long, somewhat slender and twisted or w Cones single or 2 or 3 together, 2 to 3 inches long and $\frac{3}{4}$ to $1\frac{1}{2}$ inches in diamet the base: almost sessile; scales little thickened at the ends and with a scarcely ceptible prickle; mature cones light yellowish or tawny brown. The seeds (w out wing) vary in length from $\frac{3}{16}$ to $\frac{4}{16}$ of an inch, by about $\frac{1}{8}$ of an inch in wi mostly dark brown with spots more or less confluent. Annual shoots with l chestnut bark.

6. Norway Spruce (*Picea excelsa*, D C.).

Distribution.—Throughout middle and northern Europe between latitude and 68°. It occurs alike in the plain and on the slopes of hills, but chiefly in mountainous portions of its southern range, where it reaches up to the timber-li and is the predominant tree. It has, however, been so widely introduced into calities where not found naturally as to have become one of the commonest a perhaps the largest of European conifers. It is more or less associated with Silver Fir and Scotch Pine, and becomes the predominant species, according to locality. In 1548 it was introduced into England, though not employed as a ti ber tree. It has been long known in this country as an ornamental tree, an undoubtedly the commonest evergreen cultivated in the region east of the Mis sippi, especially northward.

Growth.—This spruce, although rather slow in its growth for the first ten twelve years, is a rapid and persistent grower; in its native country it far exce our Black and White Spruces in size, vigor, and rapidity of growth. With ple of room for its side-branches it has proved, in this country at least, an excell tree for forming a shelter belt. Mature trees are from 100 to 150 feet in height, a 3 to 5 feet in diameter.

Soil and Site.—A cool humid atmosphere, with short warm summers, is the nat ral climate for its best development. In such a climate it makes very little dema on soil conditions, and will bear well a shallow compact, and somewhat dry even wet soil. In the absence of such climatic conditions, a compensation must made by specially favorable soil conditions and situations, such as a deep a permeable soil with plenty of moisture (not stagnant), a cool northern exposu and shady or light-foliaged fore-grown companions, such as larches or pines w afford. It will endure considerable shading, and its dense foliage recommends it a desirable tree for soil cover and filling wood.

As a nurse for foregrown deciduous trees this spruce deserves special attentio the more that it succeeds so well in the colder portions of the United States.

Propagation.—One of the easiest of the conifers to raise from seed, which is produced plentifully every four to six years, usually maturing in November. The percentage of germinating seed is exceptionally high (95 to 98 per cent.), and if carefully kept in the cones in a cool, dry atmosphere it retains its vitality for a long time (five to six years), losing only 15 to 20 per cent. of its germinating power during this time.

Sow rather thinly, covering the seed somewhat less than one-fourth of an inch, protecting the bed from the sun and keeping it moist. The seed thus sown will germinate readily in three to four weeks, but the seedlings make very little progress the first year, possibly 2 to 3 inches; they can therefore be left in the seed-bed for two years, thinning a little the second year in case they are much crowded; the third year they can be transplanted in rows giving more room (1 foot), and the following year they will be in good condition for transplanting to their permanent sites, an operation which they bear very well. During the first three or four years seedlings develop the root system more vigorously than the aerial part of the stem, and the more if the transplanting be continued annually for some time. Seedlings from four to six years old, set as many feet apart, will accommodate themselves until they have reached a useful size for poles, etc., before they need thinning. The seed of this species is often sown very thinly with some annual grain crop and the young plants left to shift for themselves in their permanent sites, the open places being afterward filled with other seedlings.

Quality of Wood and Economic Uses.—The wood is light, rather soft, and strong; its durability is said to vary according to the soil in which it is grown, the most durable and elastic timber being produced in a cool site and a rather rich moist soil; while that from poorer and drier soils is said to be far less excellent. Where grown to large dimensions it is employed for lumber (especially flooring) and building timber, as well as for many kinds of round timber.

Descriptive Characters.—Leaves single, bristling nearly all around the branches, about 1 inch long, sharp-pointed, 4-sided, slightly curved. Cones borne at the ends of the upper branches, hanging down, 5 to 7 inches long, and 1 to 1¾ inches in diameter; scales thin, horny, smooth, and with irregular teeth at the ends; of a light russet-brown color; seeds small, plump, almond-shaped, much pointed at one end, ⅜ to ½ of an inch long and ⅛ of an inch wide, with the wing about ¾ of an inch long; mostly dark chocolate brown. Branches long, in whorls, and sometimes horizontal, with ends turned up, but chiefly curving upward obliquely, thickly clothed with pendent branchlets, especially near the trunk.

7. Nordmann's Fir (*Abies Nordmanniana*, Spach.).

Distribution.—Found abundantly in the mountains of Crimea and in the ranges east of the Black Sea, sometimes at an altitude of 6,000 feet. Discovered by Professor Nordmann. It was first introduced into England in 1845 and into Germany in 1848. In the United States it has been tried only as an ornamental tree, but has proved very successful as far north as Pennsylvania in the Atlantic region, and may be expected to succeed even up to the northern boundary of the United States.

Growth.—A slow grower while young, but soon increases rapidly; mature trees ranging from 80 to 100 feet in height and 3 feet in diameter, with straight, smooth trunks.

Soil and Site.—This fir possesses a remarkable adaptability to different soils, but from a limited number of experiments it is evident that it succeeds best in moist, well-drained soil of medium richness; it will, however, give good results in almost any soil not extremely wet or dry. If planted on a slope the northern exposure should be chosen. It endures frost better than other firs, as it does not begin to grow until late in the season.

Propagation.—The seed is still expensive, and like all firs, is of low germination, and must be used when quite fresh. Sow rather thinly in a bed of rich, well-prepared soil. The seedlings require considerable room in the seed-bed, as they are robust and spreading in habit, developing better at first if not too much crowded. Transplant to permanent sites at the age of one or two years, giving them a little extra care until they are three or four years old, still allowing them plenty of room. Like all firs it endures shade very well; and for this reason is desirable for filling wood; but as long as the seed remains expensive it can be obtained only for trial or ornament, for the latter purpose being unsurpassed.

Quality of Wood and Economic Uses.—The wood is harder than that of most of the firs and somewhat elastic. It is adapted for building purposes, as well as for cabinet-making, telegraph poles, and for all purposes to which the spruces are put.

Descriptive characters.—Easily recognized from its very dense and beautiful dark, glossy, green foilage. Leaves comb-like on the branches, but not apparently in two

ranks, ⅝ to 1 inch long, flat, thickish, and usually notched at the tip; dark gr above and whitish on the under surface (a white line on either side of the midr Mature cones about 5 inches long and 2 to 2½ inches in diameter, erect on branches, set upon short thick stems, slightly flattened at the top; scales lar blunt, overlapping very closely, and curved so as to appear cup-shaped; a protru ing, rather heart-shaped bract attached to the base of each scale, its point extendi beyond and curving down upon the scale below. Bark of the branches and tru smooth and with exceedingly vigorous appearance; branches marked with rou pits—leaf-scars.

8. Douglas Spruce.

(Red Fir. Yellow Fir. Oregon Pine. *Pseudotsuga Douglassi*, Carrière.)

Distribution.—Same as *Pinus ponderosa*, except that it extends farther nort ward (latitude 55°), and is absent in the Black Hills. It reaches its best developme in the northwestern part of its range and usually forms large forests of pure growt It was discovered in America by Menzies in about 1797, and introduced into En land by David Douglas in 1826, and has since become well known and highly priz as an ornamental tree; lately much esteemed as a forest tree in Germany and oth countries of central Europe.

It has been for some time successfully grown in the Atlantic region, especially the middle portion, but only as an ornamental tree; though its excellent qualitie ease of propagation, hardiness, and rapid growth recommend the extension of i area as a forest tree, especially on the western prairies and on exposed sites, se coast, etc.

Growth.—The Douglas Spruce is a long-lived tree, growing rapidly and persis ently for from four to five hundred years; it surpasses almost all the conifers in th rapidity of its growth, as well as in its ability to endure drought and shade; reaches a height of 100 to sometimes 300 feet, with a diameter of 2 to 10 feet.

Soil and Site.—The Douglas Spruce possesses great adaptability and endures a v riety of conditions. In its natural state it occurs from the sea-level to an altitu often of 10,000 feet; it succeeds best, however, on slopes of moderate elevation wit a southern exposure, or at least with some protection from the north, and in a coo moist, moderately rich sandy soil—necessarily a well-drained one; an absolute poor but well-drained soil with a warm exposure is preferable to a stiff rich so with a cold exposure. Bottom-lands with porous subsoil are agreeable to th species. It will bear a cold wet situation, but generally with poor results.

Propagation.—The seed, at present still expensive, is more easily handled tha that of most other conifers. They are reddish brown on one side and whitish o the other. Sow moderately thick in beds or boxes in a light, well-pulverized soi covering the seed somewhat less than ¼ of an inch. Fresh seed will germinate i from three to four weeks, but when old is apt to "lie over" for nearly a year. Th bed should be shaded and kept evenly moist during the germination and earl growth of the seedlings. They can remain one year in the seed-bed, protected du ing the winter, and the following spring transplanted in rows. Two- or three-yea old seedlings may be used for forest planting. It is a rather hardy species and eas to handle, the young plants bearing the transplanting with little loss.

Quality of Wood and Economic Uses.—The wood is hard, strong, and durable, bein much prized for lumber, piles, mast timbers, etc., and the bark is often employed fo tanning. It appears from recent investigations that, contrary to the rule wit other conifers, the broader the annual rings in the Douglas Spruce the better th quality of wood; its rapidity of growth, therefore, is an advantage. Broad-ringe wood is equal to the European Larch, and narrow-ringed equal to the best Norwa Spruce or Pine.

Descriptive Characters.—Leaves slender, flat, comb-like in arrangement on th branches; ½ to 1½ inches long, with short stems and blunt point; silvery whit beneath. Cones 2 to 4 inches long and about 1 inch in diameter; somewhat cylin drical or ovate: three-pointed bracts protruding from among the scales. Seed reddish brown on one side and whitish on the other. Bark grayish brown; whe young smooth, but in old trees rough, deeply furrowed, and often over 1 foot thick Easily recognized by its pointed purplish buds and bracted cones.

9. Bald Cypress (*Taxodium distichum*, Richard).

Distribution.—Along the Atlantic coast from southern Delaware to southern Florida, westward along the Gulf coast nearly to western Texas, and following the Mississippi Valley as far north as southern Illinois and Indiana. In the swampy

localities and along the rivers of the Atlantic and Gulf region, forming extensive and valuable forests of pure growth, though in some places more or less associated with Gums and White Cedar. It has been successfully grown in the Northern and some of the Western States (Kansas), though chiefly as an ornamental tree.

In about 1640 it was introduced into many parts of Europe and England, and in 1746 into Scotland. There appears to be no difficulty in propagating this tree in these countries, being found to thrive and even bear perfect seeds in the climate of England. It has, however, not been tried as a timber tree, except to a limited extent in Germany.

Growth.—The Cypress is a very long-lived (about four hundred years) and rapid growing tree, producing valuable timber in a comparatively short time. It usually attains a height of from 60 to 150 feet, and 3 to 12 feet in diameter; the trunks are exceedingly broad at the base, but diminish somewhat rapidly a few feet above. The density of forests of pure growth is remarkable, the trunks often standing so close together as to be difficult to get at in felling.

Soil and Site.—In its natural habitat the Bald Cypress is found most extensively in low bottom-lands along streams, and in miry, partly or wholly submerged swamps; yet it is very capable of adapting itself to the poorer, drier, and shallower soils of the uplands, producing fairly good results as a timber tree. If placed in a dry soil, the nearer to water the better; for it is a fact of observation that while it can maintain itself very well in soils with but little moisture, at the same time the best results in point of timber are to be had in the moister soils; but this should not discourage planting in other than moist soils.

Although growing in dense forests in its natural state, it is a tree that must have an abundance of light for its crown. When not associated with other trees its own rather thin foliage offers but little obstruction to the light supply of its companion.

Propagation.—The Cypress is quite readily propagated from cuttings placed in a moist soil either in the spring or fall. They can also be made to take root perhaps more quickly in a thick "puddle" or in pure water. In all cases the cuttings should be well shaded. Propagation from the seed, however, is preferable. The seed possesses considerable vitality, germinating, of course, most readily the first year, though a fair percentage often coming the second year, if not kept in too dry a place in the mean time. It is a rather difficult matter to tell good from bad seed unless the seeds are cut open; in fact, to one not familiar with them, the seeds do not appear to be seeds at all from their external form, having a thick woody covering, in form somewhat like worthless scales of the cones ("balls"). If the cones are obtained and kept during the winter, usually the perfect seeds detach themselves as the balls become dry and open up.

Sow early in the spring in a deep, loose, rich soil, covering the seed about one-fourth of an inch, being careful to keep the bed well moistened. The seedlings should be well protected from the heat and cold during the first summer and winter at least. In the following spring the plants are best moved from the seed-bed and placed in rows, as, if allowed to remain longer, the tap-root goes very deep into the ground, forming but few lateral roots, and soon becomes difficult to transplant. Shifted in this manner for about three years in the nursery rows, the seedlings form a vigorous root system and can be transplanted to their permanent sites without difficulty at almost any time.

Quality of Wood and Economic Uses.—The seasoned wood is rather soft, quite strong, and generally very durable when exposed to the weather or in contact with the soil. A specific difference is, however, noted between the durability of timber grown in swamps and that grown on uplands, the former being of much lighter color and said to be less durable, while the latter is of a darker color, more resinous, and more durable. The two kinds are locally known as the "White" and "Black" Cypress.

Although the excellent qualities of this timber have long been recognized in small local consumption, yet it is chiefly within the last decade that the waning supply of pine timber has pressed the cypress into more general service and made its usefulness apparent. It is variously estimated by lumbermen and consumers as inferior, equal, and superior to the White Pine of the North and the Yellow Pine of the South; and while it can not well be compared with either of these pines for some special purposes, at the same time it undoubtedly combines so nearly the good qualities of both, with the addition of some peculiarly its own, that it deserves and is fast earning an equal position as a material most widely applicable for construction. At present large quantities of this timber are manufactured into lumber of almost all kinds and shingles, as well as being extensively employed for posts, piles, ties, and in cooperage. The difficulty experienced in lumbering the cypress perhaps retards considerably a steady advance in market value, as well as in consumption.

Descriptive Characters.—Leaves deciduous; flat, comb-like, or two-ranked on the branches, about ½ to ¾ of an inch long. Cones ball-like, ¾ to 1 inch in diameter composed of close-fitting, hard, plate-like scales; when young each scale bears a protuberance in the center, but it disappears mostly at maturity; two seeds usually attached to each scale and, as already remarked, not at all seed-like in appearance they are irregularly triangle-shaped, remotely resembling a beech-nut, with a thick woody, sharp-edged covering of a rich brown color and the surface more or less coated with resin. Branches ascending quite in the manner of the Lombardy Poplar. The trunks are conical in form, tapering rapidly from a broad base, which is often deeply channeled longitudinally.

Grown in the open the trunk is branched to the ground, forming a conical crown but as it nears the limit of its growing period the side-branches are lost and the crown becomes flattened, as is also its habit when grown in the forest. The trees in the forests have their trunks free from branches sometimes to a distance of 60 or 70 feet. The Cypress is peculiar among all trees for producing "knees"—oblong, dome-shaped growths protruding from the ground and varying in diameter from 2 inches to a foot or more. These growths are hollow, but their function in relation to the tree is still a matter of conjecture, beyond the supposition that they may serve for aeration. The trees grown in the open on high land are entirely without these growths.

10. Red Cedar. (Savin. *Juniperus Virginiana*, Linn.)

Distribution.—The most widely distributed of our conifers, if not of any known tree, extending from the Saskatchewan in Canada southward through Minnesota to the Gulf, and eastward throughout the entire region to the Atlantic, being especially well developed in Florida; in the Rocky Mountain region from Colorado to British Columbia; also in Arizona, Utah, and Nevada, but more abundant and best developed in the southern part of its range. It is a tree that has been long known both in this and countries abroad, where it thrives nearly as well as in its native habitat. It was introduced into England and Europe in about 1664, and has since become generally abundant, extending even into northern Asia. As an exotic, however, it is grown chiefly for ornamental purposes.

Growth.—The growth is very variable, according to soil conditions, site, and especially climate. It is a moderately rapid and persistent grower when its needs are carefully studied and supplied. In many parts of its range, often little more than a shrub; but as a tree it is commonly from 30 to 40 feet high, with a diameter of ½ to 1½ feet; in favorable situations it sometimes attains a height of 90 feet with a diameter of 3 feet.

Soil and Site.—Without doubt the most adaptive of our conifers to soil and climate, in its natural state growing in a great variety of soils, from dry to moist and even wet (swamps of Florida). As a timber tree, it gives the best results in a mild climate and in a moderately rich, light, deep, moist, but well-drained soil; either bottom or upland lime-soils are not objectionable. It endures a rocky, almost impenetrablel soi of slopes and ridges perfectly well, but its progress here is very slow; southern exposures are therefore not as favorable as those less liable to dry out. Valleys are especially agreeable to this Cedar, the usual richness of the soil promoting an excellent growth. Its ability to endure shade is remarkable, especially that of deciduous-leaved trees.

Propagation.—Seeds can be planted as soon as ripe; but burying in moist sand during the winter will fit them better for spring planting; the same effect is of course produced by fall planting, but in the latter case the covering must be heavier to prevent washing out. If kept otherwise than as suggested the seeds germinate very slowly, quite late in the season, and often not until the following spring, as they have hard shells and a more or less resinous pulp about them that withstands the effect of moisture for some time.

Sow in a rich, sandy loam bed, covering the seeds about one-fourth of an inch, and keep the bed constantly moist. The seedlings will need protection from the sun in summer and cold in winter for at least two or three years (north side of a building or other shelter), and they can remain in the seed-bed during this time, if thinned to 6 inches or a foot in the row.

Transplanting in the nursery rows will favor root development and increase the capacity to endure cold and drought. In the warmer parts of its range it requires but little care in propagating, barren hills and old fields being rapidly taken possession of by natural seeding, often sharing such places with the Scrub Pine. A desirable conifer in the Southwest for producing a soil cover.

Quality of Wood and Economic Uses.—The wood is light, soft, rather brittle when old, and straight-grained, the reddish heart-wood being remarkably durable in con-

tact with the soil. Instances are not uncommon of large post timber standing in the ground half a century with but little deterioration. It is highly esteemed for cabinet and finishing lumber, yet at present difficult to obtain of sufficient size and quantity to be much used for these purposes. The large trunks are often unfit for lumber, without much waste, because of deep longitudinal grooves formed in the growth, thus reducing the available diameter greatly (yet this peculiarity is often less frequent in forest-grown trees). Where it can be had the timber is, however, much used for posts and ties, and considerably for the wood of lead-pencils.

Descriptive Characters.—Leaves needle-pointed, mostly in alternate opposite pairs (sometimes in threes) of two kinds; those of the young shoot rather loosely arranged, awl-shaped; those on the older branchlets shorter, scale-like, and closely overlapping. The berries are about $\frac{1}{4}$ of an inch or less in diameter, ovate, with few small, scaly protuberances; ground color, brownish purple, but white with bloom: ripe in October. The foliage is very dense and of bright green, except in winter, when it becomes tawny, especially in cold climates. According to the position, the crown may assume a long or short, broad or narrowly-conical form.

11. California White Cedar.

(Bastard Cedar. Post Cedar. Incense Cedar. *Libocedrus decurrens*, Torrey.)

Distribution.—Pacific coast, south of latitude 45°, northern Oregon, to the San Bernandino Mountains, southern California. Here associated with the Yellow Pine (*Pinus ponderosa*, Dougl.), also with the Redwoods. It has been introduced in the Atlantic region south of latitude 42°, and found to be perfectly hardy and of excellent growth at Washington, D. C.

Growth.—It is a rapid growing tree, but if attempted north of latitude 40°, on the Atlantic side, a rather poor soil should be chosen to produce a slow growth, and possibly curtail its extended growth late in the season, thus lessening the chances of injury from extreme cold. Bears seed at rather early age. It attains a height of 80 to sometimes 140 feet, and 3 to 7 feet in diameter. Its compact pyramidal form and dense, dark-green foliage render it highly ornamental.

Site and Soil.—In its natural state found chiefly at elevations between 3,000 and 8,500 feet, being peculiar to slopes and valleys and along water-courses in a light, sandy soil. The best growths are, however, usually found where the soil is slightly moist but well-drained. A limited trial of this species in the Atlantic region shows that it is quite adaptive, succeeding in the plain as well as in hilly and rather dry situations. Avoiding extremely wet and dry soils, and always securing a well-drained one, this tree may be expected to succeed very well on this side of the Rocky Mountains. It must, however, be noted that with the proper soil conditions at hand care should be taken to select protected and warm aspects, for this tree is peculiar for putting out new growth late in the season, which, unless in a sheltered position, is apt to suffer from extremes of cold. Its peculiarly narrow crown will probably make this species exceedingly useful for planting in "tail places."

Propagation.—As this species is not unfrequently confounded with the Canoe Cedar (*Thuya gigantea*) from the same region, it is perhaps important to note that the seed of the latter are distinguished from those of the former by having a wing all around, as well as altogether not being more than one-third as long. The seed is liable to deteriorate rapidly if kept long; hence for spring planting care should be taken to obtain seed ripened the preceding fall.

Fresh seed sown in well-prepared seed-bed, and kept moderately moist, will germinate in from fifteen to twenty days. As soon as the seedlings appear above ground they should be protected from the hot rays of the sun. Leaving the plants in the seed-bed for at least one year, it will be advisable to shield them also during the winter, but this, of course, will generally be unnecessary in the milder climate of the Southern States. After the first few years generally hardy.

Quality of Wood and Economic Uses.—The wood is very light, soft, and brittle, but possesses remarkable durability in contact with the ground or in situations alternately dry and wet. It is, however, somewhat (native grown) liable to the attacks of a fungus which renders it unfit for use. With the Redwood it compares favorably in every respect, in the absence of which being often used for the same purposes. Locally the timber is extensively employed for posts, fencing, interior finish, shingles, laths, etc.

Descriptive Characters.—Leaves closely overlapping on the flat branchlets and with bases running down (decurrent—a distinguishing feature) and arranged in four rows, the pairs of leaves opposite. Leaves of the young plant awl-shaped, to $\frac{3}{8}$ of an inch long, standing away from the branchlet; glaucous green; cotyledons (seed-leaves) two, $\frac{1}{10}$ of an inch wide and about 1 inch long. Leaves of mature plant scale-like, points short, usually blunt, the leaf lying close to the branchlet,

which on the flat sides appears to have three rows of leaves; pale green and somewhat shiny. Cones solitary, erect at the ends of the branchlets, ¾ to 1 inch long about ½ an inch wide, and of a light-brown color; composed of four outside scales one pair short, the other large, fleshy, and clasping a fifth flat, central scale, usually 3-pointed, each large scale bearing two long-winged (at one end) seeds ¼ of an inch long.

12. Lawson's Cypress (*Chamæcyparis Lawsoniana*, Parlatore).

Distribution.—A very local and probably restricted species found along the coast of southern Oregon from latitude 43° southward, and along the valley of the upper Sacramento River, northern California, between latitude 40° and 42°. More common and better developed in Oregon than in California, where it is somewhat rare; usually associated with hemlock and Douglas Spruce; rarely forming forests. It was discovered in the Pacific region in about 1855, and in 1856 it was introduced into Germany and France, and has since become quite generally known and cultivated as an ornamental tree in England and Scotland.

Growth.—This cypress is very variable in its rate of growth, which may be due to its great tendency to "sport," thus producing forms correspondingly variable in hardness; but by proper selection hardy trees of rapid growth may be secured. Under favorable conditions trees of this species may attain a height of 40 feet and a diameter of 2½ feet in twenty years. It is a long-lived tree, of a vigorous and handsome appearance, mature specimens reaching 100 to sometimes 180 or more feet in height and from 4 to 10 feet in diameter.

Soil and Site.—Grows naturally in low, moist, rich soils. In the Atlantic region it has been found to be quite adapted to other soils, though succeeding but poorly in a hard, dry soil, especially if subject to long drought. Of other upland soils a loose sandy loam gives the best results. Low clay soils, if sufficiently drained, are not unfavorable to this tree, as are also well-drained bottom-lands. It often endures exposed and elevated sites, but is said to be not quite hardy in such locations, sometimes being injured during severe winters. For trial, therefore, a sheltered position should be chosen, and, if possible, near the influence of water. A rather poor than too rich soil is best, if to be grown in any but a mild climate, for a rich soil has a tendency to promote a late growth in young plants, and such shoots are almost always killed during the winter.

A limited number of trials with this species in the Middle Atlantic region as far north as latitude 41° give reason to expect that it may be successfully cultivated in this climate; yet it must be noted that on the whole this species succeeds better in the latitude of southern New York and Pennsylvania than in that from Virginia and southward, the chief difficulty in the latter case being its inability to endure the sudden extremes of heat and cold. A period of warm and moist weather stimulates a rapid growth, which, unless very well protected, is almost sure to be killed back by a sudden and long-continued drought. The general experience, however, as to hardiness can not be considered as satisfactorily settling the character of the tree until more carefully selected seed has been used in the trials.

Propagation.—This species can be readily propagated by cuttings, a means that has been much resorted to by nurserymen in the absence of seed. But seedlings are very easily raised. Care, however, should be taken to secure perfectly fresh seed, as it does not retain its germinating power long, and at best only a small percentage germinates. Sow early in spring, rather thickly, in a well-prepared bed of light, sandy loam, covering the seed lightly, somewhat less than one-fourth of an inch; keep the soil slightly but evenly moist. Fresh seed will usually germinate in from fifteen to twenty days. As this species grows quite slowly at first, the seedlings may be well started in a box during the winter, and in the spring carefully transplanted in a bed. They should be sheltered from the hot sun in the summer, as they are apt to burn, especially when very young. A covering of light débris or banking for protection in the winter seems desirable, at least for two or three years; and they are best kept as long as this in the seed-bed and nursery rows, giving them room from year to year by thinning and transplanting.

Quality of Wood and Economic Uses.—The wood is light, rather hard, but easily worked, strong, and exceptionally durable in contact with the soil. The resin gives the wood a highly fragrant odor, one that is very offensive to insects, and hence the wood is rarely attacked by them. Although of limited extent in its native habitat it is one of the most highly esteemed timbers in the Pacific region and ranks alongside of the redwood for economic uses. Where abundant it is manufactured into lumber and used for various kinds of fine interior work, as well as being especially valuable in boat-building. The smaller timber is used for ties and posts. The grain of this cedar is exceedingly straight and almost entirely free from knots, splitting and working most satisfactorily.

Descriptive Characters.—Leaves of the adult plant grayish-green, scale-like, in opposite alternate pairs, oval in form, rather bluntly pointed, small ($\frac{1}{10}$ of an inch long), arranged in four rows, overlapping very closely and forming slender, flattened, or somewhat four-sided branchlets; each leaf usually marked on the back with a small gland or pit. Cotyledons or seed leaves two, and about $\frac{1}{2}$ an inch long. The young leaves succeeding these are lance-shaped, sharp-pointed, about $\frac{1}{4}$ of an inch long, and the ends standing away from the stem; but older leaves becoming shorter and pressed to the branchlets; glaucous green, a feature at this age which distinguishes it from the closely allied *Cupressus Nutkaensis*. Cones globe-like, solitary at the ends of the branches, about $\frac{3}{4}$ of an inch in diameter, light-brown, but glaucous when young; usually composed of six somewhat 4- to 5-sided plate-like scales, each with a straight pointed protuberance in the center; scales generally bearing three russet-brown seed, which are ovate or orbicular and winged mostly on two sides. A very handsome and graceful tree with dense foliage; the branches mainly ascending, with the extremities somewhat drooping. It resembles *Cupressus Nutkaensis* closely, but can generally be distinguished by its more slender form.

13. Black Locust. (Locust. Yellow locust. *Robinia pseudacacia*, Linn.)

Distribution.—Originally indigenous chiefly to the mountainous region from southern Pennsylvania to northern Georgia, and possibly westward to Arkansas and Missouri, but has now become very commonly introduced and naturalized throughout the region east of the Rocky Mountains, and extending into Canada. It is more or less employed as an ornamental tree, and has been considerably planted in the Western States as a timber tree; but its quite general failure, through the attacks of borer, has brought it into disrepute, though it is believed that this cause of failure can be obviated, if not entirely removed, by the maintenance of certain conditions possible, and perhaps not hitherto appreciated. It rarely forms extensive pure growths, excepting, perhaps, in southern Pennsylvania, where it is most abundant, being mostly associated with other deciduous trees, or in small, scattered groves.

The Locust has been long known and highly esteemed in England and Europe for the economic value of its timber, and therefore the subject of much speculation as a forest tree. In 1635 it was introduced into France, into England in 1640, and into Germany in about 1696. It received more attention in England as a forest tree for ship timber, and the efforts were attended by more success, though of no great importance, than were the first trials in the other countries. In France large plantations started from seed were generally failures, although these were afterward found to be due mostly to improper soil-conditions, as well as an imperfect knowledge of other requirements, which later became better known, so that at present the Locust is successfully grown for vine stakes and many other minor purposes. In Germany it is receiving more attention now as a forest tree, though its culture is still somewhat restricted.

Growth.—The growth of this tree is very rapid, especially in rich, loose soils. It is not, however, a long-lived tree nor persistent in growth, rarely producing much after fifty years, and will attain its maximum timber value in from twenty to thirty years. During its early growth it makes an average of 3 to 4 feet in height, and nearly one-half an inch in diameter. During the first twenty to thirty years the average accretion is much greater than at any other time. Once established, coppice growths are easily maintained, as it sprouts vigorously from the stump and root. It usually attains a height of 40 to 80 feet with a diameter of 1 to 3 feet.

Soil and Site.—The largest and most quickly matured specimens of this tree are generally found in deep, loose, sandy soil, in valleys and on bottom-lands. It grows successfully on any of the poorer sandy or gravelly soils, and is generally said to produce more durable timber here than in the richer ones. In hard clay or wet soils the Locust is short-lived and its growth not at all favorable. The root system is shallow and reaches out to great distances, and the soil must be loose and penetrable, enabling the tree to appropriate its nutriment near the surface, a habit which seems to explain the rapidity of its growth, especially at first. With favorable soil-conditions the Locust succeeds almost as well on slopes and in hilly regions as in the plain.

It is variously claimed that as a forest crop the Locust impoverishes the soil. This is undoubtedly not true,* though it is evident, however, that in pure growths

* In support of this statement a writer from Kansas states that many experiences with cereals on newly-cleared locust timber land showed the yield of grain to be as great as on ground where the tree had never been allowed to grow.

it does not improve the soil, but probably from the fact that the light foilage adds little mould as well as not protecting the soil from drying out.

The question of how and what other species to associate with the Locust is of great importance and has not yet received an altogether favorable solution, although the subject of many trials and comments. But it is undoubtedly true that success will never attend a pure growth system, as far as the borer is concerned, as the total failure of many plantations will attest. Trees thinly mingled with other deciduous kinds, especially heavy-foliaged ones, are far less affected—generally entirely unaffected—by the borer, and the essential feature in this plan seems to be the production of a complete shade upon the trunks, as well as, by the interposition of different species, lessening the host-plants of the invader, rendering its general propagation difficult and slow, if not quite impossible. From this it will readily appear that the few failures with mixing have been due to the selection, not of heavy-, but of light-foliaged trees as companions; it is important, also, that they be nearly as fast-growing kinds, but not fore-grown, as the Locust is a light-needing tree and will not endure shading from above.

Propagation.—The Locust is propagated from cuttings, and very easily from cuttings of roots and from seeds; but the latter are so cheap and so readily obtained as to be altogether more advisable for forest planting. They retain their vitality for a number of years if kept in the pods or buried very deep in the ground, in the latter case having been known to grow after seven years; but seed out of the pods will not give a good per cent. of germination after being kept in a dry state for more than two years. They ripen about July or August and can be sown immediately, when they will generally come up and make a considerable start the same season; if kept for spring planting it is advisable, though not absolutely necessary, to keep the seed in moist sand and a cool place during the winter. Seed thus cared for retains its vitality better, and when sown germinates well without further trouble. Old seed, however, and that kept dry for a season is best subjected to a soaking in warm water from one to three days.

Sow rather thinly in a rich sandy bed, covering the seed one-fourth to one-half an inch deep; the seedlings will be fit to set out in their permanent sites the following fall or spring.

Quality of Wood and Economic Uses.—The wood is very heavy, strong, hard, and durable in contact with the soil and when exposed to the weather. In 1733 the English ship-builders discovered the excellence of this timber for treenails and employed it extensively for this purpose, its hardness, durability, and strength making it more desirable than other timber; it is also used for the same purpose in this country, as well as for ties, fence-posts, rails, in turnery, as well as furnishing an excellent quality of fuel, its value for the latter being four-fifths of that of Beech.

Descriptive Characters.—Leaves compound, composed of from 8½ to 12½ pairs of ovate or elliptic leaflets with fine point at the tip. The pods are brown, much compressed, 2½ to 3 inches long, and contain from 4 to 6 dark-brown or blackish seeds. Branches armed with short, curved prickles, persistent, but attached only to the bark. Bark of young trees smooth and grayish, but older it becomes thick and much furrowed. The trunks are rarely very straight, and unless closely grown the crown is apt to be open and spreading.

14. Honey Locust.

(Sweet Locust. Honey Shucks. Three-Thorned Acacia. *Gleditschia triacanthos*, Linn.)

Distribution.—From the Brazos River, eastern Texas, northward to eastern Nebraska and eastward throughout the entire region to the Atlantic, but in the latter States chiefly introduced. It is mostly associated with other trees, elm, walnut, hickory, and ash, though sometimes becoming the predominant species, and in a few cases, in small areas, excluding all other species. Outside of its natural range it has been quite generally cultivated as a shade and ornamental tree, and in a few of the Western States successfully grown in forest plantations. It is well fitted to replace the Black Locust in the southern half of the United States, where it can undoubtedly be more successfully grown as a forest tree.

In 1700 it was introduced into England, but cultivated only as an ornamental tree, and somewhat unsuccessfully as a hedge-plant, as it was also upon the Continent. Subsequently it became known in southwestern Europe, especially in France, Austria, and Italy, where fertile seeds are easily matured.

Growth.—The Honey Locust grows rapidly during its early life in favorable situations, making from 2 to 3 feet annually in height growth and nearly three-fourths of an inch in diameter for the first ten years. Although not as extensively tried as

a forest tree as the Black Locust, yet so far as known it is generally far less liable to the attacks of insects than the latter. Commonly about 50 to sometimes 90 feet in height and 1½ to 3 feet in diameter. Grown in the open it usually produces a short trunk and a broad, much-branched crown, while closely grown with other heavy-foliaged companions it develops a taller trunk and smaller crown.

Soil and Site.—The Honey Locust is found growing almost entirely in low rich bottom-lands and in sheltered valleys, where the soil is deep and loose, rarely of its own accord taking to the poorer and drier uplands. In such favorable locations it produces its finest timber value. The moderately rich, but loose, sandy, or gravelly soils of highlands and slopes produce desirable timber, though not as quickly as the lower and richer soils. The growth in stiff damp soils is apparently a healthy one, but slow and undesirable for timber; it will not endure an undrained soil.

Propagation.—It does not sprout from the stump nor grow from cuttings, and is therefore propagated entirely from the seed, which will sometimes retain their vitality for three years, even out of the pods. The fresh seeds procured in the fall grow most readily if planted immediately, but if kept dry for a season or more and then planted they germinate very slowly, often not at all, or "lie over." Old seed, however, can be made to grow by treating as recommended in the case of the Black Locust. The young plants of the first year are not quite as hardy as those of the Black Locust of the same age, but are equal to them in this respect at any time afterwards. They can be transplanted to their permanent sites when one year old and will bear the transplanting well, but are on the whole, perhaps, best kept in the nursery rows till the fall or spring following the second year.

Quality of Wood and Economic Uses.—The wood is heavy, hard, strong, and durable in contact with the soil or when exposed to the weather (equal to that of Red Mulberry).* It splits somewhat more readily than that of the Black Locust, and the grain is considerably coarser as well as being more porous. It seems not to have attracted much attention for its economic value, but where available is employed considerably for fence-posts, rails, in turnery for heavy spoke-timber, and is much esteemed for fuel. It is adapted to other purposes in construction, and will undoubtedly come into more general use in the absence of other heavy-wooded but much slower-growing kinds.

Descriptive Characters.—Leaves compound, composed of small, lance-shaped, oblong leaflets. Pods large, flat, shiny brown, 9 to sometimes 18 inches long and about 1½ inches broad, with a sweetish hard pulp between the seeds—often eaten by children. Armed with clusters of long keen spines, generally three together, a central or main one with smaller lateral ones; often attached to the trunks of young trees, but absent from older stems. The bark of young trees (ten to fifteen years) is mostly smooth and unbroken; but very old trees have rough and much furrowed bark, rendering the tree quite a different one in appearance. Varieties of this species are without thorns, or sometimes with small thorns.

15. Hardy Catalpa. (Western catalpa. *Catalpa speciosa*, Warder.)

Distribution.—A tree of somewhat local distribution, originally found mostly in southern Illinois and Indiana, western Kentucky and Tennessee, to southeastern Missouri and western Arkansas. It was for a time supposed to be identical, or at least only a form of *Catalpa bignonioides*, commoner and of more southern distribution, until about 1853, when Dr. J. A. Warder, of Cincinnati, Ohio, called attention to an evident difference between the two forms, and later gave this species its present name. It must, however, be added that as early as 1842 Dr. George Engelmann had noted a difference in the size and the time when the flowers appeared, though he gave it no further attention. Through the efforts of Dr. Warder this species has become more widely known and introduced, until at present it is one of the commonest and most highly esteemed forest trees grown in the Western States.

Growth.—The rapidity of growth characterizing this tree for the first forty or fifty years is remarkable, and the quality and quantity of timber produced in so short a time is in no case surpassed by any other deciduous or coniferous species. When planted closely on uplands of Kansas, an annual height growth of 1½ feet and one-half an inch in diameter seems a good average. In favorable soil it not uncommonly makes from 1 to 4 feet in height growth, with an average diameter accretion of about 1 inch during the early years of its growth. The increase of wood continues to be about the same up to thirty years, though there is little falling off to the age of fifty; twenty to thirty-five years, however, will suffice to produce timber of good value. It usually attains a height of 60 to 80 (rarely 100) feet, and 2 to 4 feet in diameter.

*Lately some doubt has been thrown upon the durability of Honey Locust in contact with the soil. It has not been possible to ascertain in the doubtful cases whether the timber had been properly treated after being felled.

Soil and Site.—The Catalpa prefers and grows best in low rich bottom-land, yet is very adaptive and grows well on a variety of other soils, both on slopes and in tl plain. Light-foliaged quick-growing trees are recommended to be associated wit it—Black and Honey Locusts, Black Cherry; in western localities the Green Ash an the shader slower-growing Box-Elder. The Catalpa will endure a dense side shad and can therefore be closely grown, resulting, as already stated, in the correction a somewhat straggling habit and in the production of cleaner and straighter trunk

Propagation.—Propagated readily from cuttings, but best from the seed, whic is easily obtained and one of the easiest to grow. It can be sown in the fall or spring though preferably in the spring. The seed obtained in the fall can be safely ke through the winter in a dry state with little if any loss of vitality. Soak the see in "soft-water" for about twenty-four hours and sow thickly in bed of light loam soil in rows 4 to 6 inches apart, covering to a depth of from ¼ to 1 inch, pac ing the earth somewhat firmly. The seedlings can be transplanted to their perma nent sites the following fall or spring. It will be best, however, to move them a from the seed-bed in fall and pack in a trench, banking them up rather high; o they may be placed in earth and housed in a cellar till wanted in the spring. Th young plants should be set closely in the row, or much better with other kinds, a then side branching will be prevented and the trunks will be tall and straight. Place at distance of 2 to 3 feet in the row and 4 feet apart, plantations will not requi thinning, as the strong and desirable seedlings push forward and the weaker die ou After eight or nine years' growth, though, considerable pole-timber can be cut i such places as will be ultimately lost or amount to little by the crowding of mor vigorous trees. Plantations can be advantageously cultivated, like corn, up to th end of the second year, when the ground will begin to be sufficiently shaded to ex clude weeds.

The Catalpa is also grown successfully and with less care by sowing the seed i the permanent sites and thinning the seedling to the required distance during th fore part of the season, when the superior vigor of certain plants is evident; after ward being left to themselves. Still another method, which is alike a saving o much trouble at first, is to prepare and mark the ground as for corn, and plant fou or five seed in a hill. When well started remove all but one vigorous plant and cu tivate till fall. They are then best hilled up with a small corn-plow for the winte The transplanting of the seed-bed plants is thus saved, yet on the whole not a grea saving of time, as it is little trouble to set a large number of plants when the groun is put in readiness, one man alone planting from 1,000 to 1,500 in a day.* A slit i made in the ground with a spade, the plant put in position, and the earth closed u about it by one stamp of the foot.

The practice of cutting back the first two years' growth, in order to strengthe the root system, is sometimes resorted to, and the young plants bear the operatio well, responding quickly with new shoots. Older trees also sprout well from th stump when cut for timber.

Quality of Wood and Economic Uses.—The wood is rather light and soft, moder ately strong, and very durable in contact with the soil. At present it is much em ployed for fence-posts, rails, ties, and fuel; but the beauty of the grain renders i very desirable and suitable for cabinet-work and interior finish. The sap-wood i thin and forms but a small part of the common bulk.

Descriptive Characters.—Leaves very large, heart-shaped, with long slender point and soft downy on the under side; without a disagreeable odor (peculiar to *C. big nonioides*) when handled or crushed. The flowers are almost white, 2 inches lon ⅛ of an inch longer than those of *Catalpa bignonioides*); the lower lip of the flowe (corolla) is notched—entire in *bignonioides*. Mature pods 8 to 20 inches long; th flat scale-like seeds are about 2 inches long, with thin, pencil-like tufts of hair a the round ends of the wings. It is a much broader seed than that of *bignonioides* and the latter has the ends of the wings pointed instead of rounded. The trunks, too of the western species are taller and straighter than those of *Catalpa bignonioides*

16. Osage Orange (Bois D'Arc. *Maclura aurantiaca*, Nutt.)

Distribution.—Southwestern Arkansas, southeastern Indian Territory, and south ward through northern Texas; considerably restricted in its natural range, but by cultivation widely extended throughout the region east of the Rockies; in the Prairie States, having been grown both as a forest tree and as a hedge-plant, as is its principal use in the Northern States, but as a forest tree it is without doubt fitted only for southwestern planting.

*Since writing the above a complete tree-planting machine has been patented which is fitted to prepare the ground, set, and plant the trees at the same time. A trial made in western Nebraska showed the machine capable of planting 11,500 seedlings in 10 hours, requiring the aid of 2 men and 5 horses; with more help the machine can be made to do double work.

In 1818 it was introduced into England, later (1835) into Europe, and is somewhat popularly known as a hedge-plant.

Growth.—As compared with the Catalpa or Black Locust, the Osage Orange is not quite as rapid in its growth, except perhaps in its most favorable soil and climate; and as the principal crop it requires considerable extended care to produce useful timber, twenty to thirty years for posts or ties, but four or five years will often suffice to furnish desirable poles for staking grapes as well as for some other local uses. It is inclined to be low, in the forest commonly reaching a height of 30 to 60 (exceptionally 75) feet, and 1 to 2 (rarely 3) feet in diameter, or in the Northern States little more than a shrub.

Soil and Site.—As a timber tree it attains its most valuable dimensions only in moist, rich soils in a warm climate, in its natural state being found mostly in valleys and along water-courses in fertile and loose soils. It is a very adaptive species, though, and can be grown with more or less success in almost any soil not excessively poor or constantly wet. It endures shade and drought very well.

Propagation.—The Osage Orange sprouts well from the stump, and can be propagated quite easily from layers and cuttings from the roots, but best from the seed, which are easily obtained and handled. When kept in a moderately dry condition it retains its germinating power for from one to three years, but the falling off in vitality is considerable after the first year. It is best, therefore, to procure the fresh seed in the fall, when, in a mild climate, it can be sown immediately, adding a light covering to the seed-bed to prevent washing out. If kept over for spring planting, which is perhaps most advisable for colder climates, the seed will germinate more readily if in the meantime it is mixed with moist sand and kept in a cool atmosphere. It can then be planted as soon as the frost has left the ground, and will grow without further attention. Seed kept in a dry state and then sown does not germinate as promptly as when previously soaked (one or two days) in warm water, which is very necessary with old seed; otherwise the treatment can be the same as that for the Locusts.

Timber plantations of pure growth are sometimes cultivated with a crop of corn for one or two years, the Osage Orange seed being planted in every other hill, or between the regular hills of corn one way, and at the end of the first season taking out all but the most vigorous plants. But except in its most favorable climate it is a tree hardly to be recommended for anything but a mixture with other equally as desirable, faster-growing, or fore-grown species, when nursery-grown seedlings are more desirable.

Quality of Wood and Economic Uses.—The wood is very dense, heavy, hard, very elastic, and strong, as well as being exceedingly durable in contact with the soil. Its principal use is for fence-posts and ties, and to some extent for wheel stock, paving-blocks, stakes, and fuel. The density and strength of this timber, together with little tendency to shrink in seasoning, recommend it as desirable in carriage and wagon making.

Descriptive Characters.—Leaves simple, alternate, and with entire margins; ovate, with a tapering point, 3 to 3½ inches long, and from 1½ to 2 inches wide. The apple-like fruit, remotely resembling an orange, is a large compound body, the cucumber-like seeds inclosed in long, tough, fleshy, capsule-like coverings, which are closely packed and radiate from a common attachment (receptacle) at the center of the fruit. The surface of the "orange" is smoothly tuberculate—the projecting ends of the pulpy seed coverings. When mature the fruit is greenish or sometimes orange-yellow, and varies in size from 2 to 5 inches in diameter. The branches are armed with rather slender spines (½ to ¾ of an inch long) which usually grow from the axils of the leaves. The wounded bark or green fruit exudes a milky juice.

17. Green Ash (*Fraxinus viridis*, Michx. f.).

Distribution.—The ash of widest range, occurring in all the States east of the Rocky Mountains, extending north of the United States boundary into Canada; and occurring also in the eastern Rocky Mountain ranges of Montana, the Wasatch Mountains of central Utah, and in the ranges of eastern and northern Arizona.

Introduced into England and Europe about 1824 and cultivated mostly as an ornamental tree.

Growth.—The Green Ash is a middle-sized tree of rather slow growth, making annually less than ½ of an inch in diameter and 1½ feet in height growth during the first decade. It produces clean straight trunks when rather closely grown with other shadier companions, but must have full enjoyment of light for its crown. For the first two or three years the Green Ash grows much more rapidly than seedlings of the White Ash of the same age. It commonly attains a height of 25 to 35 feet,

with a diameter of 1 to 1½ feet. Exceptional trees are sometimes 60 feet high, largest trees often being found in cultivation.

Soil and Site.—It is found growing naturally associated with other deciduous tr in deep, moist, cool soil of bottom-lands and along water-courses; in the Rocky Mou ain region in cañons. It prefers rich, moist soils and cool situations, and h produces its most favorable growth; but is on the whole less dependent up moisture than any of the other American ashes, and is therefore the one t adapted to prairie planting, as it will succeed in a dry soil and atmosphere that w not be endured by the White Ash, but in such locations it should never be plan by itself, as its thin foliage does not produce sufficient shade to prevent the soil fr becoming excessively dry.

Propagation.—Unlike other ashes, the seed of this species can be kept throu the winter, sown in the spring in a dry state, and will germinate quite readily. kept for spring planting, it is best put away in slightly moist sand in a cool atm phere till wanted. Sow rather thinly in a light, loamy, well-prepared bed, cover to a depth of one-half an inch. The seed-bed is better shaded and kept moist un the plants begin to come. The seed can be sown as soon as procured in the f adding a light covering of débris to the bed to prevent washing out, removing it the spring. The seedlings should be transplanted the following spring or the f before, setting them from 1½ to 3 feet apart in the row. The fall of the second spring of the third year the young trees will be in good shape to remove to th permanent sites, if not convenient to continue their cultivation longer in the nu ery rows. One-year-old seedlings are often used in forest plantations, and the see are even sown in the permanent sites, but the latter is not the most advsable p cedure.

The Green Ash bears seed more abundantly and at a much earlier age than t White Ash, and the trees being smaller the seed is comparatively much easier to c tain. The general resemblance, too, between the two species has led enterprising dealers to sell Green for White Ash seed; but the seeds of the former has a mu shorter wing, as well as the seed part proper being not more than one-half as lo as that of the latter. Green Ash seedlings are distinguished from the White A in being straight instead of more or less crooked.

Quality of Wood and Economic Uses.—The wood is heavy, hard, and stro though, as with other ashes, when very old sometimes brittle; but it so nearly co bines the good qualities of the White Ash that the timber is often employed f many of the same purposes, the comparatively smaller size only making it in ge eral less desirable. Used for the wood-work of agricultural implements, floorin and interior finish, as well as for fuel.

Descriptive Characters.—Leaves compound, with 2½ to 4½ pairs of leaflets, whi vary in length from 2 to 5½ inches, and from 1¼ to 1¾ inches wide; ovate, oblon ovate to lance-shaped, often with long tapering (or rounded) point, and sometim rather wedge-shaped at the base; margin entire, or with acute or blunt teeth, toothed only toward the point; bright green and smooth on both sides, but with fi close down on the midrib below. Seeds (keys) 1 to 1⅝ inches long, and ¼ to ½ (co monly ¼) of an inch wide, slender and sharp-pointed at the base, broadening in a lance-shaped or spatulate wing above; ridged. Branches round. The young see lings are remarkably straight, with smooth, clean-looking bark, features that usual distinguish them from the White Ash seedlings; the bark of the older trees in ge eral aspect is not unlike that of the White Ash. Generally distinguished from t White Ash by its leaves being bright green both sides and lacking the rust-colore buds peculiar to the White Ash.

18. Box-Elder. (Ash-leaved Maple. *Negundo aceroides*, Mœnch.)

Distribution.—One of the most widely distributed of our deciduous trees, occu ring throughout the region east of the Rocky Mountains, though more abunda southward, but less common near the sea-coast than inland. It extends north of t United States boundary to the Saskatchewan: associated more or less with oth deciduous trees throughout its range. It has received considerable attention as forest tree in many of the Western Prairie States, as well as being a general favori for shade and ornamental purposes. In England and the countries of centr Europe it has been long known, the first specimens being introduced about 1688.

Growth.—A tolerably rapid though not a persistent grower; its average annu height growth is about 1½ feet, and in diameter about one-half an inch during t first ten years (Kansas); but it is perfectly hardy throughout its range, and unde favorable conditions continues to grow well, though not a long-lived tree. It commonly a rather low tree, but sometimes attains a height of 60 feet with diameter of 1½ to 2½ feet.

The tendency to produce a short, thick trunk and a large spreading crown can be greatly modified by judicious close planting and association of heavy-foliaged companions that will exert a perfect side shade, though not retard height growth by cutting off the light from above.

Soil and Site.—This species grows most favorably along streams, in valleys, and in the rich, deep soil of bottom-lands, even if subject to periodic immdation. Although the finest specimens are found in such soil and situations, it is a tree capable of successful and profitable cultivation on a variety of the poorer and drier upland soils. It succeeds, perhaps, better in a somewhat clayey soil than in one strictly sandy or gravelly (unless contiguous to water), as under the latter conditions trees are apt to be affected by extreme drought, and in consequence shorter-lived than when grown in a soil retentive of moisture. But in general the Box-Elder is a tree for almost any soil except the very driest and one constantly submerged.

In the treeless region it recommends itself chiefly from a wide range of adaptability to soil and climate, as well as from the ease of propagation and the production of useful timber in a comparatively short time. It must also be regarded as important in quickly producing a forest cover, and thus making possible the introduction of species of more economic value, though more difficult of cultivation, except under specially created conditions; and it will of course deserve no less attention in this capacity in the regions where reforestation is less difficult.

Propagation.—The Box-Elder is readily propagated from cuttings. The seed does not retain its germinating power long, especially if kept over where it can become very dry, and is therefore best planted as soon as it can be obtained in the fall, proceeding the same as with the Green Ash, No. 17, except that the seed should be sown more thickly. The seedlings grow rapidly at first and are ready for forest planting when one year old.

Quality of Wood and Economic Uses.—The wood is rather light, soft, and lacking in strength. It is used quite extensively for wooden-ware, paper-pulp, and fuel. Where large enough it is not unfrequently manufactured into lumber and used for inside work, the white grain being very attractive when finished.

Descriptive Characters.—Leaves compound, with three to five leaflets, which are ovate, pointed, toothed on the margin, and strongly veined. The flowers appear in advance of the leaves, hanging down in long tassel-like clusters. The seeds (keys) are usually very abundant and are borne in pairs, each having a long curved, veiny, light-colored wing; produced in thick clusters on long slender stems. Young branches greenish, and the bark of the trunk remotely resembling the White Ash.

19. Golden or Broad-leaved Wattle (*Acacia pycnantha*, Benth.).

Distribution.—Native of South Australia, where it naturally occurs in open forests. It is extensively cultivated in Australia as a forest tree, as it is also in New Zealand and Australasian countries.

A few successful trials in the central and southern Pacific region seem to show that the climate is perfectly adapted to the growth of this tree, as is also, perhaps, that of Florida, Texas, and the lower Gulf States.

Growth.—Very rapid growing, but rarely more than a middle-sized tree. Instances are noted of seedlings attaining a height of 3 feet in seven months, and of trees 40 feet high and 1 foot in diameter at seven years of age; such trees yielding 300 pounds of tan-bark.

Soil and Site.—In its natural state, occurring in dry soil of hilly country, subject to sudden changes (not, however, below 26 F.) of temperature and deficient rainfall. In cultivation it has been found to be especially adapted to loose, sandy soils, here reaching its best development most quickly. In California, however, it is said even to take possession of the poorer barren sites by natural seeding, and will undoubtedly succeed in any of the drier soils not too hard, with a droughty range of temperature.

Propagation.—The seed of this species is very slow to germinate unless specially treated before sowing. Soak in warm (some recommend hot) water till soft.* Seedlings may be first raised in boxes or beds, as recommended for the locusts; but plantations are often made by sowing the seed in drills, 4 feet apart, in the permanent site, adding (in either case) only a light covering, the soil having been well prepared by deep plowing, rolling, and harrowing. Seedlings can thus be easily cultivated and the soil kept loose (very essential) until they need more room in the row. Seedlings 6 to 10 inches high can be reset from 1 to 1½ feet in the row, and if carefully done will stand the operation with little loss. Tan-bark plantations of seedlings 3 to 4 feet high usually contain about 400 trees to the acre, 10 feet apart. Sprouts well from the stump and is readily propagated from cuttings.

* Trials at the Forestry Division of seed soaked three days germinated readily only after lying in moist soil for from two to three months.

Quality of Wood and Economic Uses.—As already stated, the chief value* derive from this tree is in its bark for tanning purposes, yielding a larger quantity and better quality (?) of tan extract † than almost any other class of trees, and in som markets being much preferred to other tan-bark. The wood is said to be tough hard, and durable. The peeled timber can be, and is, quite generally employed i wagon-making, for agricultural implements, tool-handles, etc.

Descriptive Characters.—Leaves (phyllodia) lance-shaped, curved, usually narrow at the base, obtusely pointed, 3 to 6 inches long, and ¼ to 1 inch wide; somewha leathery. Pods usually straight, or slightly curved, flat, rather thin, "several inche long," and about ¼ of an inch wide; seeds shiny-black, flattened ovate-oblong with a whitish keel-shaped attachment (funicle) at one end about two-thirds th length of the seed.

20. Eucalyptus.

Distribution.—With few exceptions the Eucalypts are all natives of Australia where they form at least four-fifths of the forest vegetation. Of about 135 (to possible 150) known species 20 are cultivated as desirable timber trees.

During the last seven years the Government of South Australia has planted 1,400,000 Blue Gums; 600,000 of the Red Gum; 1,500,000 of the Sugar Gum; and 20,000 of the "Jarrah" (*Eucalyptus marginata*).

They were first discovered in Tasmania (South Australia) by the French botanist Labillardière in 1792, and a few specimens sent to England. In 1854 to 1855 the Eucalyptus was successfully introduced into southern France, Corsica, Spain, Italy Algeria, and to some extent into Egypt, Palestine, India, and South America. They have been variously experimented with in more northern countries of Europe, but the winter seasons usually prove too severe for them.

The introduction of the Eucalyptus into the United States was first attempted in about 1865, but has not generally proved to be very successful, except in California Trials in the Gulf region have almost all ultimately failed from frost, although the trees succeeded well during specially mild winters.

The liability, then, in this locality of the temperature falling below 40° F. seems to make the cultivation of these trees as forest growth questionable. But the already assured success of the Eucalyptus in Mexico and Central America would indicate probable success in southern Texas and Florida, where trials have not as yet been made to any extent.

From 1870 to 1878 about 400 acres were planted to Eucalyptus in California, and the cultivation has gradually increased, especially in the southern part of the State until up to 1882 twenty or more species had been tried and half a million Blue Gums alone were planted.

The anti-malarial effects claimed for these trees when introduced into miasmatic regions seems to be due to the fact that their rapid and vigorous growth quickly reduces or exhausts the excessive moisture in the soil (thus eliminating an important factor in the maintenance of noxious vapors), rather than to the balsamic exhalation from the leaves, which is generally believed to be the purifying agent.

Growth.—The rapidity of growth peculiar to the Gums is surpassed by no other genus of forest trees, but this reputation is shared chiefly by the Blue Gum While the growth of all these species so far cultivated for timber is very rapid, yet the Blue Gum perhaps far exceeds any, both in dimensions and in the comparatively short time required to attain useful size, twenty-five to fifty years sufficing to produce good hard timber for lumber, while the Red Gum and "Jarrah" require double that time to mature timber equally large; but of the latter two the Red Gum is the more rapid. These three species, on account of superior size and other peculiar qualities of timber, are undoubtedly to be most esteemed as forest trees.

From carefully compiled measurements taken from seedling trees in Australia the following average annual height and diameter growth is computed for the first eight years:

Species.	Average annual height growth.	Average annual diameter growth.
	Feet.	*Inches.*
Blue Gum (*Eucalyptus globulus*)	7	1
Sugar Gum (*Eucalyptus corynocalyx*)	5	1
Red Gum (*Eucalyptus rostrata*)	4	1

* A plantation of 100 acres of *Acacia decurrens* in Australia gave a net profit of $5,540 in seven years.

† The bark containing ordinarily from 25 to 30 per cent. of mimosa tannin.

Exceptional cases in all species are noted where in specially favorable soil and other conditions the figures here given would be exceeded; but they give fairly the possibilities of each species under average circumstances. The height growth of the gums (notably that of the Blue,* as with most trees) is very marked in early life, and according to the species reaching its maximum in from twenty-five to fifty years; subsequently the growth is mostly in diameter.

The Blue Gum is generally considered to be the largest, commonly reaching a height of 200 to 300 and sometimes 400 or more feet, with a diameter of 10 to 15 (exceptionally 30) feet. Single planks are sometimes obtained from the trunks of this species 100 to 150 feet long. The Red Gum is usually a smaller tree, attaining a height of about 100 feet, with a proportionately large diameter: exceptional cases, though, have been noted of trees 250 feet high and 14 feet in diameter. The Jarrah commonly grows from 40 to 100, and exceptionally 150 feet in height, with a diameter rarely exceeding 10 feet; trunks of the largest specimens are sometimes found free from branches for 80 feet. The Sugar Gum commonly attains a height of 120 feet and a diameter of 5 to 6 feet, the trunk often 60 feet to first branch.

Soil and Site.—In its natural state the Eucalyptus is found chiefly in warm, moist, rich soils. The Blue Gum is adaptive to many sites and succeeds well on dry upland soils, although bottom-lands are more favorable, as they are also to the growth of all these trees, especially the Red Gum, which will thrive even in a soil with stagnant moisture, in its natural habitat seldom occurring away from moist oases: but for a desert country, however, the Sugar and Red Gum are said to be the most desirable, being very capable of enduring extreme heat and prolonged drought.

In California they are found to thrive well in dry stony soils of slopes, often where the soil is scanty. If tried in a climate subject to occasional frost a rather poor sandy soil should be chosen, as it will retard the formation of immature wood late in the season.

It is asserted by some writers that other trees can not be grown successfully with Eucalyptus, at least not nearer than 30 feet. Their feeding capacity is very great and the roots often extend to a distance of 30 or 40 feet horizontally, as well as going deep into the soil in search of moisture, the Blue Gum perhaps being the most aggressive. Trees, then, less vigorous in appropriating nutriment and moisture may eventually succumb or develop but poorly when associated with stronger and more aggressive companions.

Propagation.—The seed is perhaps most satisfactorily germinated in boxes open in a warm room or covered with glass. A convenient size is 2 by 3 feet and 6 inches deep: they should be filled nearly full of light sandy soil and a top layer of sawdust added in which to sow the seed. Sow somewhat thinly and cover to a depth of one-fourth to one-half an inch. Seed can be readily germinated in soil, but the covering must be very slight (less than one-fourth of an inch) and the soil very loose, as the young plants do not seem to readily push through a compact surface, the necessary watering generally producing this effect: the layer of sawdust is therefore best, as it offers no resistance to the germinating seed. In either case the seed-box must be kept damp, and a covering of glass conserves the moisture and maintains a higher temperature, which is essential during germination; but when fairly up the plants will need more air.

A growth of six to eight weeks will bring them to sufficient size for permanent planting. Best, however, at the end of the first month to reset them in a bed, giv-

*In a plantation of 130,000 trees of this species in Oakland, Cal., belonging to Gen. J. T. Stratton, it is stated that many of them made an average of 10 feet per year in height and 3 inches in diameter. Messrs. Elwood Cooper and J. S. Barker, of Santa Barbara, mention two trees in their plantation, only eight years old, respectively, 115 feet high and 22 inches in diameter, and 85 feet in height and 2 feet in diameter.

Mr. Cooper also makes the following estimate in regard to the comparative yield of timber when planted at different distances:

Distance apart.	Age of trees.	Yield of wood per single tree.
	Years.	*Cord.*
to 7 feet	6	¼
2 feet	6	¾
ingle trees	8	1

ing each plant more room (3 to 4 inches in a row) or thin to this distance. Shad plants during first season, as they are most tender at this time.

The ground intended for the permanent site should be well cultivated and free from clods. Seedlings of one year are said to be at the most favorable age to en dure transplanting, and this is best done when the ground is moist from recen rain, or, if in dry weather, the seedlings can be planted with the earth undisturbe about its roots, but first adding a half bucketful of water to the hole and settin the plant in after the water has sunk away. It is recommended to plant seedling 6 to 7 feet in the row, that they may be readily cultivated till large enough to shad the ground.

In California the Eucalyptus trees bear seed abundantly, but as yet there has bee no reproduction from natural seeding, due perhaps to the usual dry and unfavor able condition of the soil for germination near a forest of these trees; the extension therefore, of Eucalyptus forests has so far been possible only by artificial planting

Quality of Wood and Economic Uses.—The wood of the Eucalyptus is quite gen erally useful and valuable, but the several species supply a demand for timber o special character not possessed by other forest trees.

Blue Gum.—Wood hard and very strong, having about the same elasticity as tha of White Ash. Tests of its resistance to crushing weight showed an ability to sus tain 14 pounds more per square inch than the English Oak, and 17 pounds more than the Indian Teak. It is largely employed for ship timber, heavy deck planks in wagon-making, etc., as well as having a general use in other construction, fenc ing, posts, and ties; its life for the latter purpose being about nine years.

Red Gum.—The wood of this species is very heavy, a cubic foot weighing from 50 to nearly 60 pounds, and its durability in contact with the soil, together with its power to resist the attacks of the Teredo and other destructive agencies peculiar to sea-water has made it valuable above all other species, except the Jarrah, in ship building, for piles, posts, dock timbers, ties, and various structures subject to the deteriorating influence of soil and water; also well adapted and used for many minor purposes. The life of this timber for telegraph poles and ties is about twelve years, and sometimes longer.

Jarrah.—As already stated, this is the only species that rivals the Red Gum in the remarkable strength, durability, and power of its wood to withstand the attacks of the Teredo, etc. It is somewhat heavier than the Red Gum, a cubic foot of seasoned wood weighing about 64 pounds; but its uses are much the same as those of the Red Gum, with it and the Sugar Gum constituting perhaps the three most important species of gum for underground and pile structures.

Sugar Gum.—The wood of this tree is very hard, strong, and durable, being chiefly employed for fence posts and ties, for these purposes having shown no signs of decay after being in use for fifteen years.

DESCRIPTIVE CHARACTERS.

Blue Gum (*Eucalyptus globulus*, Labill).—Seed leaves* of the young plants opposite, sessile, and heart-shaped; those of the adult tree 6 to 12 inches long, lance-to ovate-lance-shaped, curved, with long points; veins conspicuous.* Young shoots and foliage sometimes glaucous white. Bark somewhat fibrous, but falling off and leaving a smooth trunk. Seed rather large, black, somewhat kidney-shaped, about $\frac{1}{8}$ of an inch long, and usually much wrinkled.

Red Gum (*Eucalyptus rostrata*, Schlecht).—Leaves lance-shaped, 3 to 6 inches long, curved, with a slender point; lower ones sometimes ovate-lance-shaped and straight. Fruit nearly globular, $\frac{1}{4}$ of an inch in diameter; seeds very small, about $\frac{1}{20}$ of an inch long, light russet brown, somewhat triangle-shaped. Bark of the trunk grayish white, generally smooth and separating into layers, rarely persistent and rough.

Sugar Gum (*Eucalyptus corynocalyx*, F. Muell).—Leaves thick, leathery, generally rather broad, lance-shaped or ovate, blunt or sharp-pointed, 3 to 5 inches long. Fruit ovate, about $\frac{1}{2}$ an inch long, sometimes strongly ribbed; seed dark brown, about $\frac{1}{10}$ of an inch long, somewhat ovate or elliptic, flattened, smooth, and convex on one side, pitted and wrinkled on the other.

Jarrah (*Eucalyptus marginata*, Smith).—Leaves often thick and leathery, 3 to 6 inches long, lance- to ovate-lance, shaped; upper surface dark green, lower whitish. Fruit ovate (broader at the top end), about $\frac{1}{2}$ an inch or more in diameter; seed large, black, remotely triangle-shaped, convex and finely corrugated on one side, more or less irregularly scalloped on the other, and somewhat drawn out to a truncated point, which is marked by a light-colored scar.

*Mature leaves of all the Eucalypti are peculiar for a vein running along the margin of the leaf, joined by veins from the mid-rib.

Number of seeds in an ounce and approximate number of lineal feet they cover when sown in drills.

No.	Name.	No. of seeds in an ounce.	No. of lineal feet covered.*
1	White Pine (*Pinus strobus*)	1,800	18
2	Red Pine (*Pinus resinosa*)	1,760	50
3	Short-leaved Pine (*Pinus mitis*)	1,990	50
4	Bull Pine (*Pinus ponderosa*)	100	8
5	Calabrian Pine (*Pinus Laricio*, var. *Calabrica*)	2,130	28
6	Norway Spruce (*Picea excelsa*)	5,260	35
7	Nordmann's Fir (*Abies Nordmanniana*)	610	10
8	Douglas Spruce (*Pseudotsuga Douglasii*)	4,200	27
9	Bald Cypress (*Taxodium distichum*)	†320	16
10	Red Cedar (*Juniperus Virginiana*)	1,310	18
11	California White Cedar (*Libocedrus decurrens*)	1,260	20
12	Lawson's Cypress (*Chamæcyparis Lawsoniana*)	6,400	40
13	Black Locust (*Robinia pseudacacia*)	1,810	36
14	Honey Locust (*Gleditschia triacanthos*)	210	8
15	Hardy Catalpa (*Catalpa speciosa*)	1,230	40
16	Osage Orange (*Maclura aurantiaca*)	820	14
17	Green Ash (*Fraxinus viridis*)	1,020	17
18	Box-Elder (*Negundo aceroides*)	920	14
19	Broad-leaved Wattle (*Acacia pycnantha*)	1,770	22
20	Blue Gum (*Eucalyptus globulus*)	10,800	70
	Red Gum (*Eucalyptus rostrata*)	‡116,640	1,160
	Jarrah (*Eucalyptus marginata*)	§8,840	77
	Sugar Gum (*Eucalyptus corynocalyx*)	17,060	80

* For practical use it will be necessary to reduce these figures in proportion to the percentage of germination found in the seed employed; see p. 65.

† About 50 per cent. of the bulk of cypress seed in the trade consists of refuse shells of cones.

‡ The figures here given are for perfectly pure seed; but as ordinarily obtained the pure seed amount to only about 15 per cent. of the common bulk.

§ Also impure, the common bulk containing only about 30 per cent. of pure seed.

In addition to these notes I may be allowed to reproduce the last chapter of my report on the Forestry of the Western Plains, which, for lack of funds, has not yet been printed.

SUGGESTION OF A METHOD OF PLANTING FOR THE PRAIRIES.

Although, as has been shown, the advantages to be derived from close planting would appear such as to recommend close planting as an invariable rule, I wish to offer a modification of the rule as generally practiced, which I believe will better meet the requirements and capabilities of the prairie planter. What are the objects of timber planting in the prairie? So far, no attempts being made to plant for supply of the general lumber market, the timber is planted (1) to furnish fire-wood; (2) to furnish material for fence-posts, tool stock, or ties and sills; (3) to give shelter against winds and to cover the soil for forest effects, and these results should be attained in the cheapest and quickest manner.

It is a well-known fact that in an open stand trees grow in diameter at the expense of height growth. A lawn tree will spread its crown and grow in the bole, but soon ceases to grow in height. This is the influence of a full enjoyment of light. In close planting each individual must strive to get the needed amount of light, and in this struggle each tries to carry its own crown higher than its neighbor, but the energy expended in the struggle is lost to the trunk development, until the victory of the quickest growing assures to its crown fuller supply of light.

In systematic forestry, which, carried on over large areas, is designed to supply a lumber market with its manifold requirements without anxiety for quick returns, and which works for the produc-

tion of long timber, advantage is taken of this tendency; close planting is practiced to produce height and clean growth, and at the proper time, by judicious thinning, opportunity is offered for diameter development. But the farmer, who works for quick returns and wishes to produce only special sizes of timber besides his fire-wood, may well be excused from vying with the wholesale forest-grower. He wants to grow for his own needs in the first place and at the smallest cost.

By wider planting of the valuable kinds he saves in the initial cost of plant material.

By underplanting with a cheap material, which may be readily procured from the river banks, he supplies the necessary soil covering in even larger amount, without greater expense. This will grow the fire-wood and produce the necessary forest effect, shading the ground and sufficiently trimming the foregrown valuable kind, which, by this method of treatment, will soonest grow to valuable size.

These trees, to be sure, will grow less in height, forming rather short trunks, but they will grow in diameter, and make posts, or even railroad ties, in half the time that they would if they had first been stimulated to develop height growth.

The ideal selection of material for such planting would be a quick growing, light-foliaged, valuable post or tie timber, with a slower growing, shade-enduring nurse or undergrowth, just quick enough growing to trim the bole of the foregrown one, but leaving its crown free to the full influence of the sunlight. The development of the undergrowth to valuable size being of secondary consideration, it should be planted or sown as densely as practicable.

To give an advantage to the valuable kind, if it is not by itself of considerably quicker growth than the undergrowth, it would be advisable either to plant it in larger specimens or combine planting and sowing, or else plant or sow the undergrowth several years later than the dominant growth. In the latter case it will be advantageous for two or three years to cultivate the ground for potatoes or other root crops, thus utilizing the ground and reducing the cost of cultivation for the trees.

The modifications of this method, according to the nature of the trees to be used for the planting, can be easily applied by keeping in view the principles of forest growth before stated. A large variety of combinations could be proposed. The light-foliaged quick-growing Black Locust or Honey Locust might properly be underplanted with Box-Elder, Soft Maple, Elm, or Osage Orange, and an occasional Catalpa as nurses. The latter may even be so intermixed as to become the dominant tree. The Catalpa, grouped with the slower-growing but shade-enduring Box-Elder and Mulberry, would make a straighter growth than it is apt to make by itself. With this kind the order of planting might even be reversed, especially if it is cut down after the first year's growth. The sprouts will then make quick and straight growth between the surrounding box-elders.

I would not recommend a closer planting of the dominant growth (using plants of the best quality) than 200 to 300 to the acre, being about 12 to 15 feet apart. The undergrowth may be put in as closely as possible, either by sowing or planting. This in a few years may be of sufficient size for fire-wood, when it can be cut and the sprouts from the stocks will quickly cover again the ground. In this way fire-wood may be cut three or four times while the dominant growth remains to attain requisite sizes for posts and ties.

CONDITION OF FORESTRY INTERESTS IN THE STATES.

The following brief reviews of the condition of the forestry interests in each State and Territory have been compiled from various sources, among these the correspondence with the secretaries of State, of horticultural, and other societies, with professors of agricultural colleges, and other persons informed on the subject, to whom the thanks of the writer are hereby acknowledged. The object of this compilation is to give, in a rapid glance, an idea of the position which each State takes at present towards this growing interest in its natural, educational, and legislative aspects. To bring these reviews into the short space available has often necessitated an undesirable brevity; nevertheless, it is hoped that the presentation of the most important points will serve the good purpose of showing where we stand at present, in what direction further development of State interests is needed, and in what manner this development may be best promoted.

In some instances, where new developments hitherto not reported have occurred, more space has been devoted to them, as in the case of Massachusetts and New York. The arrangement of States has been made geographically, in the same order as followed in my previous report.

MAINE.

(12,000,000 acres wooded, or 62.7 per cent., of which 22.4 per cent. is in farms.)

Originally the entire State was covered with pine, spruce, and hemlock, with hard woods largely interspersed. The old growth of white pine is mostly cut out, only small scattered patches remaining, in at present inaccessible places, but fine hard-wood timber abounds, especially in the central portions of the State. The immense forests in which the large rivers of the State find their sources were originally worked for the pine. Since its exhaustion they have been worked for the spruce. The White Pine is largely replaced by a rank growth of spruce, birch, and other hard woods.

The abundant virgin growth of maple, birch, and other hard woods, which has hitherto possessed no commercial value, from the fact that the rivers furnished the only route for the logs to the mills, may eventually, when railroads are built into the wilderness, make these woods of more value to the owners than even the pine and spruce.

From the important position which the lumber business of the State once occupied it has gradually dwindled down; yet the annual product of the forest may still be placed at $11,000,000 to $12,000,000 for timber and fire-wood, representing, say, 220,000,000 cubic feet, of which 45 per cent. is lumber.

The conviction that the commercial and industrial importance of the State must be based largely on its forest wealth has induced a change of policy in regard to the working of the forests, and more sensible and economical management has taken the place of the former wasteful methods. This consists mainly in keeping out fires and in not allowing trees below a certain size to be cut, a condition which enters into the land-holders' leases to the loggers. The owners of the wild timber lands, whose holdings are in large tracts, often comprising one or more townships, clear no land and sell no land.

In the southern counties the young pine now springing up freel on abandoned farming lands is carefully protected.

It is the belief among prominent lumbermen that the annua growth of wood equals or even exceeds the cutting.

The interest of the State in forest property led, as early as 185 to the passage of an act "to protect forest and timber land fro fire, and to punish the unlawful and careless kindling of fires; amended in 1885 by substituting imprisonment for the fine imposed Of the 1,000 acres of land set aside in each township for public pu poses, probably a good deal is timbered, but no enactment in refe ence to these lands exists.

Tree-planting for shade and ornament is practiced throughout th State. Arbor Day was appointed by the governor, upon recom mendation of the legislature, in 1887. The State Grange, havin a committee on "Arbor Day and Forestry," suggests, among othe recommendations, that town assessors be required to make return as to forest areas and lumber industry, so that the state of this im portant interest may be better known from year to year than it ca be from the annual statistics as now gathered by the Secretary o State.

No instruction in forestry is given, but Prof. F. L. Harvey, of th State Agricultural College, properly remarks: "We are interested i establishing the distribution and rate of growth of our timber trees the best age to cut them for the greatest yield of lumber, the suc cession of timber"; and he should have added, the best mode of ac celerating the greatest yield from natural forests.

NEW HAMPSHIRE.

(3,000,000 acres woodland, or 52 per cent., of which 43.2 per cent. is in farms.)

With over half of her area untillable and covered with wood growth—hard woods with spruce in the northern and pine and hem lock in the southern parts—relying largely upon the water-power o her streams and finding a large pecuniary value in the fine scenery of her mountains, which attracts visitors from all parts of the coun try, there should be considerable interest in this class of property yet but little has been done to preserve these resources from needless devastation.

No legislation exists of any practical service. The State legisla ture appointed a Forestry Commission in 1881 to report upon the condition and needs of forestry. As a result a very valuable, im partial report, full of practical, conservative recommendations and suggestions, was published in 1885 and widely circulated through the State, but has remained as yet without consequences in additional legislation. In the report, many examples of the shrinkage or irregu larity of water flow in the rivers of the State, concomitant with de forestation, are noted. The crude product of the forest in 1880 was placed at about $5,000,000, or half of the value of the agricultural crops.

The losses from fire are placed at about one-fourth in value of what has been cut. Although there exist laws for the prevention of fires and fixing the responsibility for fires occasioned by railroads, "it is doubted whether these statutes have had any appreciable effect in curtailing the number or destructiveness of forest fires;" the reason is probably because the laws are not enforced. In regard to regulations by towns respecting the kindling of fires, "it is manifest that a local option law on this subject can never be of much practical use." The

laws stop considerably short of affording the measure of protection and security which the people may fairly expect and require.

Imposing the duty of enforcing the laws upon some designated town officer, as has always been insisted upon by the writer, is found by the Commission to be the needed remedy.

Forestry forms one of the regular studies at the State College of Agriculture, with Dr. Hough's "Elements of Forestry" as text-book.

Prof. Henry G. Jesup writes:

> Very little, if anything, has been done by individuals to protect their private interests, other than an occasional attempt to enforce existing laws against the firing of woods.
>
> We have no public lands, and, with the exception of our finest first-growth timber, which will soon be gone, our supply of wood for all ordinary purposes is and must be so abundant that our people are not disposed to think seriously of the injury to our streams and the fertility of our soil from the needless destruction of the growth that covers our hills and mountains.

MASSACHUSETTS.

(1,389,500 acres woodland, or 27.8 per cent., in farms.)

With the exception of a few inaccessible ridges, where black spruce, hemlock, and broad-leaved trees show the original growth, the forest area, reported as 27.8 per cent. of the total area of the State, is stocked with second growths of hard woods and white pine, yielding material for cooperage, wood pulp, wooden ware, box boards, and for charcoal or fire-wood. Some plantations, made with a view to financial returns or as protection against winds, are reported from various parts of the State. These were mostly planted or seeded with White Pine, Pitch Pine (*P. rigida*), and European Larch, with as yet indifferent success as to profitable investment, although some white pine, planted twenty to forty years ago, has been cut for box boards. Conditions of the lumber market, besides the desire to realize too soon from the investment, will probably account for this lack of success. From advance sheets of decennial census of 1885, furnished by the State Bureau of Statistics, we are enabled to construct the following tables:

LAND IN FARMS.

Classification.	1865.	1875.	1885.	Value.	Percentage of value to that of all farm property.
Cultivated land ..... acres..	881,402	942,521	939,260½	$59,891,808	27.70
Unimproved land ..... do....	1,052,374½	1,469,988½	1,479,454½	25,529,690	11.80
Unimprovable land ..... do....	282,359	89,457½	90,212½		
Woodland ..... do....	1,019,343½	930,402½	1,389,501½	25,279,209	11.69
Total land in farms ..... do....	3,235,479½	3,402,368½	3,898,429½	110,700,707	*51.19

WOODLAND IN FARMS.

	Acres.	Value.
Over thirty years' growth	317,297	$8,770,459
Of thirty years or less	992,563½	15,189,962
From seeds or transplanted seedlings	5,913	83,471
Not classified	73,728½	1,235,317
Total	1,389,501½	25,279,209

		Cubic feet.	Value.
Fire-wood:			
For sale	cords..	289,885¼	27,828,980	$950.62
For use	do....	284,108	27,274,370	881,88
Lumber:			
For sale	M feet..	63,314½	5,276,165	632,66
For use	do....	9,055¼	754,600	107,43
Railroad sleepers	number..	423,124	1,480,934	160,56
Other wood products (estimated)			1,500,000	191,39
			64,115,050	2,924,57

Timber or wood, growing or cut, destroyed by forest fires:

Number of owners	55
Value	$82,25

A marked increase in the percentage of woodland as compared with the amount reported for 1865 and 1875 will be noticed. This is to be accounted for probably as the result both of a more careful and exact classification of lands and the abandonment of farms or portions of farms on high hills or mountain sides and in other localities, because no longer remunerative for agricultural use, but which have been appropriately devoted to tree growth.

Within the last five years considerable attention has been given in this State to forest legislation. As this has been evidently formulated with care, and in that spirit of self-government which seems to pervade the communities of Massachusetts especially, the recent laws are here given in full:

AN ACT for the protection of forests against fires.

SECTION 1. Whoever wantonly and recklessly sets fire to any material which causes the destruction or injury of any growing or standing wood of another shall be punished by fine not exceeding one hundred dollars or by imprisonment in jail not exceeding six months. (Chap. 163, 1882.)

AN ACT for the better protection of forests from fires.

SECTION 1. Whoever willfully or without reasonable care sets a fire upon the land of another by means whereof the property of another is injured, or negligently or willfully suffers any fire upon his own land to extend beyond the limits therof by means whereof the wood or property of any other person are injured, shall be punished by fine not exceeding two hundred and fifty dollars.

SEC. 2. In all towns it shall be the duty of the selectmen to appoint within thirty days after the passage of this act, and thereafter annually, in March or April, one or more persons, to be called firewards, who shall, in respect to fires in woodland, have and exercise the powers and duties prescribed for firewards in chapter thirty-five of the public statutes. In towns of less than three hundred voters the selectmen may serve as forest firewards if the towns shall so elect.

SEC. 3. It shall be the duty of forest firewards to post copies of this act and chapter one hundred and sixty three of the acts of the year eighteen hundred and eighty-two in two or more public places, to investigate all cases of fires in woodlands and report thereon to the mayor of the city or to the selectmen of the town, who in their discretion shall cause complaints to be made for violation of the provisions hereof.

SEC. 4. The mayor and aldermen and selectmen shall make return to the insurance commissioner, as required in chapter thirty-five, section ten, public statutes, of all forest fires in their respective cities and towns in which more than one acre is burned over.

SEC. 5. The engineers of fire departments in cities where a fire department exists shall have and exercise the powers and duties herein prescribed for forest firewards.

SEC. 6. Forest firewards may employ such assistance at the expense of the city or town as they see fit to suppress forest fires, and shall receive such compensation as the city or town may determine. (Approved June 16, 1886, chap. 296.)

AN ACT authorizing towns and cities to provide for the preservation and reproduction of forests.

SECTION 1. The voters of any town, at a meeting legally called for the purpose, and the city council of any city, may, for the purpose of devoting a portion of the territory of such town or city to the preservation, reproduction, and culture of forest trees for the sake of the wood and timber thereon, or for the preservation of the water supply of such town or city, take or purchase any land within the limits of such town or city, may make appropriations of money for such taking or purchase, may receive donations of money or land for the said purposes, and may make a public domain of the land so devoted, subject to the regulations hereinafter prescribed. The title of all lands so taken, purchased, or received shall vest in the Commonwealth, and shall be held in perpetuity for the benefit of the town or city in which such land is situated.

SEC. 2. A town or city taking land under this act shall, within sixty days after such taking, file and cause to be recorded in the register of deeds for the county or district in which the land is situated a description thereof sufficiently accurate for identifying the same. In case such town or city and the owner of such land do not agree upon the damage occasioned by such taking, such damage shall be ascertained and determined in the manner provided in case of the taking of land for a highway in such town or city, and such town or city shall thereupon pay such sums as may finally be determined to be due.

SEC. 3. The State Board of Agriculture shall act as a board of forestry, without pay, except for necessary traveling expenses, and shall have the supervision and management of all such public domains, and shall make all necessary regulations for their care and use and for the increase and preservation of the timber, wood, and undergrowth thereon, and for the planting and cultivating of trees therein. The said board shall appoint one or more persons, to be called keepers, to have charge, subject to its direction, of each such public domain, enforce its regulations and perform such labor thereon as said board shall require; and said keepers shall have the same power to protect such domain from injury and trespass and to keep the peace therein as constables and police officers in towns.

SEC. 4. Said board may lease any building that may be on any such public domain on such terms as it shall deem expedient. All sums which may be derived from rents and from the sales of the products of any such domain shall be paid to said board and shall be applied by it, so far as necessary, to the management, care, cultivation, and improvement of such domain; and any surplus remaining in any year shall be paid over to the city or town in which such domain is situated. Said board shall not, however, expend upon or on account of any such public domain in any year a greater amount than it receives as aforesaid.

SEC. 5. A city or town in which any such public domain is situated may erect thereon any building for public instruction or recreation, provided that such use thereof is not in the judgment of said board inconsistent with the purposes expressed in section one.

SEC. 6. No land shall be taken or purchased, no building shall be erected on any such domain, and no expenditures shall be authorized or made or liability be incurred under this act by any city or town until an appropriation sufficient to cover the estimated expense thereof shall in a town have been made by a vote of two-thirds of the legal voters of such town present and voting in a legal town meeting called for the purpose, or in a city by a vote of two-thirds of each branch of the city council of such city; such expenditures shall in no case exceed the appropriations made therefor, and all contracts made for expenditures beyond the amount of such appropriations shall be void; and all expenditures under this act shall be subject to the laws of this Commonwealth limiting municipal indebtedness.

SEC. 7. For the purpose of defraying the expenses incurred under the provisions of this act any town or the city council of any city may issue from time to time, and to an amount not exceeding the sum actually expended for the taking or purchase of lands for such public domain, bonds or certificates of debts, to be denominated on the face thereof the "Public domain loan," and to bear interest at such rates and to be payable at such times as such town or city council may determine; and for the redemption of such loan such town or city council shall establish a sinking fund, sufficient, with the accumulating interest, to provide for the payment of such loan at maturity. All amounts received on account of such public domain shall be paid into such sinking fund until such fund shall amount to a sum sufficient, with its accumulations, to pay at maturity the bonds for the security of which the fund was established. (Approved May 25, 1882, chap. 255.)*

*Under this act the town of Lynn has secured control of 150 acres of forest lands, apparently, however, more for park than forestry purposes.

RESOLUTION authorizing the collection of forestry statistics.

Resolved, That the chief of the bureau of statistics of labor is hereby directed to incorporate in the blanks for taking the next decennial census such inquiries as shall determine as far as practicable the acreage of the woodland in the Commonwealth over thirty years' growth, the average age at which the forests of the Commonwealth are now cut off, and such other inquiries as may be practicable fully to determine the facts as to the cultivation, protection, and depletion of the forests throughout the Commonwealth. (Approved May 24, 1884, chap. 55.)

RESOLUTION relative to the establishment of an Arbor Day.

Resolved, That his excellency the governor is requested to set apart in each year the last Saturday in April as Arbor Day, and to issue his proclamation recommending that it be observed by the people of the Commonwealth in the planting trees, shrubs, and vines, in the promotion of forest growth and culture, in the adornment of public and private grounds, places, and ways, and in such other efforts and undertakings as shall be in harmony with the general character of a day so established. (Approved April 9, 1886, chap. 32.)

EXEMPTION FROM TAXATION.

Chapter 11, section 7, of the general statutes provided:

SEC. 7. All plantations of Chestnut, Hickory, White Ash, White Oak, Sugar Maple, European Larch, and Pine timber trees, in number not less than two thousand trees to the acre, upon land (not at the time of said planting woodland or sprout land and not having been such within five years previously), the actual value of which at the time of planting does not exceed fifteen dollars per acre, shall, together with the land upon which the same are situated, be exempt from taxation for a period of ten years from and after said trees have grown in height four feet on the average, subsequently to such planting.

PROTECTION OF TREES.

The statutes also forbid cutting down, destroying, or injuring willfully and maliciously or wantonly and without cause, by girdling, lopping, or otherwise, fruit or other trees standing or growing for shade, ornament or other useful purpose, and provide as penalty imprisonment in house of correction not exceeding six months, or fine not exceeding $500.

In regard to the law exempting plantations from taxation, Mr. W. R. Sessions, secretary of State board of agriculture, writes: "I do not think that this law had any effect, unless it may have called the attention to the subject of forestry. Those who have set out plantations are generally men of wealth, who have done it to please themselves. The statutes which have for their object the protection of forests from fire are like all other public regulations they may be useful, but can not prevent much loss from forest fires."

Mr. F. H. Appleton refers to the work of the agricultural and horticultural societies in the interest of forestry, notably that of the Massachusetts Society for promoting Agriculture, which has offered liberal prizes to encourage tree-planting, and expects this year (1887) to award a large prize for an extensive plantation of larch in North Andover. In 1886 extracts from those parts of the statutes which related to the protection of the forests from fire were printed and sent to every city and town in the State, and in 1887 the same were reprinted on water-proof card-board.

The reports of other agricultural societies and of the State Horticultural Society show also considerable interest in the work, which has been fostered by the introduction of Arbor Day and by occasional addresses on the subject in and out of schools.

The Arnold Arboretum, connected with Harvard University, under the skillful superintendence of Prof. C. S. Sargent, well known by his census work on forestry, promises when completed to be one of the most valuable aids to forestry in an educational direction.

The following extracts are from a letter by Prof. S. T. Maynard, of Amherst:

It is a fact beyond question that there are to-day more acres of woodland in this state than there were twenty-five years ago. The hill farms are being deserted and he pasture lands are fast running up to timber. In many places this growth is of esirable material, like White Pine, Oaks, and sometimes Maple and Chestnut, but nore often the first growth is White Birch, Alder, and Scrub Oak. With a little udicious attention and a little expense, much of this poorly stocked land might be nade to bear the best quality of wood and timber.

The plan which seems most feasible for New England, and which will be successful if properly followed, is to fill out those lots or plantations that are only partially tocked with trees with such as can be easily transplanted or grow from seed in tony land that can not be cultivated. In this State alone we could find 500,000 acres f land that is not suitable for cultivation and is not valuable for grazing purposes, ut could be utilized in this way.

The trees that we find to succeed, transplanted in this way, are the European arch, White Pine, Black Poplar, Ailanthus, Gleditschia, and the Willows, of which he White Willow is more planted than any of the others.

The White Poplar, Balm of Gilead, Linden, and Yellow Locust have been so inured by borers as to be worthless for lumber.

As to the forestry work at the Massachusetts Agricultural College, experiments n a small way have been made from time to time to test the value of different species f trees for forest and ornamental purposes, but no large plantation has been made. n 1874 a barren hillside was covered by Larches, Scotch and Austrian Pines, which ithout any care whatever have made a fine growth, many trees being over 45 feet igh and from 10 to 12 inches in diameter.

The instruction given to the students consists in a study of the principles of forestry, heir importance, influence upon climate, temperature, rain-fall, and the general elfare of other crops as affected by them. They are taught the various methods f propagation of forest and ornamental trees, the names and characteristics of all ees of value for forests or ornamental purposes, together with the insects injurious them.

This subject is one of the utmost importance to New England, as well as the rest f the States, and we could make many experiments and do much in this line of ork if our finances would allow.

RHODE ISLAND.

(163,528 acres wooded, or 24.2 per cent.; all in farms.)

Forests in the strict sense of the word can hardly be said to exist n this State, "although over 24 per cent. is reported covered with ood, mostly coppice and white pine or pitch pine, which here and here may be said to rise to the dignity of forests, especially on the estern borders." The total forest area in farms, according to the nsus of 1885, was 163,528 acres (a seeming increase of of 7,074 acres ver the State census of 1875, but a decrease of over 19,000 from national nsus figures of 1880), valued at $2,762,341, and yielding $371,000, 13.4 per cent. of its valuation, a remarkable result, the largest elds coming from the northwestern towns of Gloucester, Scituate, oventry, and West Greenwich.

Some lumber, shingles, and railroad ties (about 600,000 cubic feet all) for home use are manufactured, but most of the wood is cut r fire-wood (over 9,000 cords), which finds a ready market in the nsely populated villages (254 inhabitants to the square mile). The mber of saw-mills in 1875 was 81, with a product of 2,250,000 feet, hich sunk to half that amount in 1880; but in 1885 is again reported 2,955,125 feet.

The statutes provide for careless or willful firing of woods imprisment not exceeding two years; "but," writes the secretary of the ate board of agriculture, "I do not know of a case being prose-

cuted under it. This board has discussed the question of furth legislation for the protection of our woodlands, but has arrived at n definite conclusion." Arbor Day has been established since 1886 as legal holiday.

Some forest planting for profit has been carried on by private in dividuals.

There are in the State extensive tracts of land which, though c so light a soil as to be valueless for purposes of cultivation, may ye be converted into forests and thus made to yield an income, as show by the very striking experiment of the late Zachariah Allen, and a is now being illustrated on a large scale by Henry G. Russell, a Warwick.

CONNECTICUT.

(650,000 acres woodland, or 21 per cent., of which 99 per cent. is in farms.)

The forest area of the State, covering the rugged and stony hill sides, consists entirely of coppice growth, which is cut in rotation of about thirty years, for fire-wood mainly.

There was a law to prevent fires on woodlands passed in the yea 1886, but as usual "many forest fires have occurred, and the proba bilities are that while most of them are accidental they would no have occurred had the law been obeyed" or enforced, but no provi sion appears in the act for its enforcement.

Additional legislation in regard to the liability of railroads in caus ing fires exists. The stock laws, restraining the running at large o cattle, seem to be generally observed.

Besides some legislation in regard to planting on roadsides the fol lowing recent enactment is noteworthy:

AN ACT to encourage the planting of forest trees.

SECTION 1. The governor shall annually in the spring designate by official proc lamation an Arbor Day to be observed in the schools and for economic tree-planting

SEC. 2. Chapter forty-nine of the public acts of eighteen hundred and seventy seven is hereby amended to read as follows: Whenever any person shall plant lan in this State not heretofore woodland, the actual value of which at the time o planting does not exceed twenty-five dollars per acre, to timber trees of any of th following kinds, to wit, Chestnut, Hickory Ash, White Oak, Sugar Maple, European Larch, White Pine, Black Walnut, Tulip, or Spruce, not less in number than twelv hundred to each acre, and such plantations of trees shall have grown to an aver age height of six feet, the owner of such plantations may appear before the boar of relief of the town in which such plantation is located, and on proving a compli ance with the conditions herein, such plantations of trees shall be exempt from taxation of any kind for a period of twenty years next thereafter. (Approved March 31, 1886, Chapter XC.)

Since 1873 a few lectures on forestry and tree culture have been given each year to the students in the agricultural course at Yale University.

VERMONT.

(1,990,000 acres woodland, or 32.5 per cent., of which 79.1 per cent. is in farms.)

The forests in this State consist of broad-leaved trees with occa sional patches of Black Spruce and White Pine, the latter mostly ex hausted. The Green Mountain range and some of the northern coun ties are reported to contain Black Spruce in virgin condition. Much of the woodland reported is, of course, second growth and coppice. Essex County is the heart of the lumber region of the State; the ag-

gregate production of the mills in 1885 was estimated at 332,000,000 feet, of which 80 per cent. was spruce, most of which was exported. The State owns no lands.

This is perhaps the only State which places by law a premium upon the removal of the forest, exempting the owners of migratory sawmills from taxation upon their timber lands for five years.

In 1882 a Commission similar to that created in New Hampshire was appointed, and a résumé drawn from the inquiries of that commission was furnished in a report in 1884, containing much common sense and many good suggestions. From this it appears that from 70 to 90 per cent. of the native forest has been cleared off in the best agricultural portion of the State; that nature does much to reforest old pastures and abandoned lands, though the remarks upon the "natural succession of forest crops" lead to the presumption that this new growth is not always of desirable kinds.

The replies indicate that there is less damage experienced from forest fires than might be expected, though this is considerable in the aggregate. Fires are often started by careless and irresponsible persons, and a law to be of much effect must take notice of this fact.

The replies to the questions in regard to the effect of the removal of the forest upon springs, streams, and ponds, with scarcely an exception, tell the same story. The water supply is year by year failing, and the smaller springs and streams which had never until recently been known to fail often become totally dry in a dry season.

The replies to this question are more full and specific than those given to any other. "The deposit from the overflow of streams has changed in character; is more sandy, showing that it is the wash not from the rich mold of the forest, but from bare hillsides, scarred by ravines, cut deeper at every freshet for want of the protecting forest. It is undoubtedly true that our climate is gradually changing."

No recent legislation in consequence of this report has been enacted. Under the existing fire law, malice and willfulness must be shown in order to obtain redress for damages from incendiaries.

As to instruction in forestry matters, so far as known this is given only in occasional lectures at farmers' institutes by the secretary of the board of agriculture. These instructive lectures are printed collectively with others from time to time.

NEW YORK.

(8,000,000 acres woodland, or 26.2 per cent., of which 64.9 per cent. is in farms.)

The wood growth of this State consists mainly of broad-leaved forests, through which in the northeast were scattered spruce and pine and hemlock, and along the Hudson coniferous species covered the foothills. With the exception of the northern counties the woods are mostly coppice and second growth. As a lumber producer New York has long ceased to be of much account, though higher prices for lumber may yet occasion the production of considerable amounts of spruce and hemlock in the less accessible northern forests, which have remained comparatively intact. In some parts "log burning" is still practiced, and much hemlock, from which the bark is stripped, is left to rot in the woods.

New York has had the advantage of having public lands, mostly woodlands, in the Adirondack and Catskill Mountains, allowing her, or rather imposing a duty upon her as a State, to take active

measures for their preservation and protection. Accordingly, afte much agitation of the subject and a preliminary investigation by temporary Commission in 1884, a Forest Commission was created i 1885 for the purpose of administering wisely and upon conservativ grounds this property of the State, and for its working the sum o $32,500 was appropriated, but "of this apparently available amoun a large part can not be used, owing to the limitations of the appro priation act."

The first report, issued in 1886, contains, besides a full synopsis of the existing State legislation pertaining to the preservation of trees and forests and a list of the few books which may be found in our public libraries on the subject of forestry, a detailed description of the holdings of the State and some general reports on the forest conditions of the counties in which the Adirondack forest reserve is situated with recommendations for further legislation and other matters of interest.

The second report, issued in 1887, is interesting as showing the results of the work of the commission. The almost absolute immunity from fires upon the State lands, which comprise over 715,000 acres, must certainly be hailed as a good result. The complete arrest of all trespassing, timber thieving, and depredations, and the recovery of $14,000 for trespass and timber illegally cut, should in itself be considered a good return for the expenditure of $30,000 in all.

Noteworthy also is the immediate influence upon the value of surrounding forest property, which is benefited by this protection, and immunity of the Government lands from fires. Such land is now held at prices many times in advance of what it could have brought before.

The officers of this first American Forest Administration are, besides the three commissioners without salary, a secretary, a warden, an assistant warden, two inspectors, and fifteen foresters, with a monthly pay-roll of $1,375.

A full account of the Catskill reserve forms part of the report. The rehearsal of statements in regard to the value and importance of forests and forestry is well designed to impress the citizens of the Empire State with the need of better provisions for this important part of their empire.

Whatever may be the shortcomings of this first attempt at making a reality of forest preservation, it should be encouraging enough to induce the National Government to do its duty in protecting the remaining timber lands on the public domain.

The previous legislation of the State (1876) contained provisions, which, if properly executed, would have prevented many forest fires. It even charged justices of the peace, supervisors, and commissioners of highways with the duty of extinguishing fires, allowing them to order out the necessary help, and making it a misdemeanor to refuse aid in the work. The forfeiture for refusal, $50, was to be applied as reward for superior exertions in extinguishing fires. Negligence in setting fires was sufficient to establish misdemeanor. Protection of shade trees and of timber or forest growth was provided, and an extensive legislation in regard to the public domain existed before the Forest Commission was established.

The act establishing this commission contains also additional fire legislation, ordering the division of each town into fire districts, the appointment of fire wardens, reports by supervisors of areas and values destroyed, requiring railroad companies to keep their right-

-way clear of inflammable materia, and their locomotives provided
ith spark-arresters, and demanding other measures of caution.

The Forest Commission is to take charge of "the public interest
the State with regard to forest and tree planting, and especially
ith reference to forest fires in every part of the State," and "to
ake, and post publicly, rules for the prevention and suppression of
es."

Such rules have been made as follows:

(1) All persons having occasion to light a fire for burning a fallow, or for purposes
clearing or improvement, shall give five days' notice of such intention to the
arest fire warden. He shall also give notice to all owners or occupants of adjoin-
g lands, at least forty-eight hours previous to setting such fires, and these fires
ll be permitted only when the wind is favorable. Competent persons must re-
ain on guard until the fire is completely extinguished, and no such fires will be
owed until the trees are covered with mature foliage.

(2) Besides the fires specified in the foregoing rules, fires are permitted in or near
e forest for cooking, warmth, and insect smudges, but all other fires are abso-
tely prohibited. Persons kindling a fire for any of the purposes herein mentioned,
e directed to clear away all combustible material for a space of six feet about the
ace where it is to be kindled, and to thoroughly extinguish the fire before leaving
e neighborhood, either temporarily or permanently.

(3) Hunters in the use of fire-arms are hereby cautioned against allowing fires to
rt from such cause. Smokers are also reminded of the danger to the forest from
eir carelessness, and all persons are hereby warned that any damage or injury to
e forest which may be caused by their acts or omissions will be deemed to result
m their culpable carelessness.

(4) Peeling or girdling trees of their bark for covering camps or shanties is hereby
hibited. For such purpose the trees must be felled and all bark removed there-
m before another tree is cut down. The trees thus felled, and such fallen timber
lies in the vicinity, must be used for fire-wood or in camp construction before
y standing timber is cut for that purpose.

The secretary of the commission, Mr. Abner L. Train, says: "Our
e laws are good; perhaps the machinery for enforcing them is not
t as complete as it should be; legislation is needed in the direction
perfecting the means for putting the laws in force."

The stock laws in the State, unfortunately, are not applicable to
ld and forest lands.

The commission is also charged with the education of the people
forestry matters by publication of tracts, circulars, and otherwise.

n the agricultural college of the Cornell University, the land grant college of
State of New York, a course of instruction in forestry was instituted in 1874,
l has been regularly continued since that date. This instruction consists of a
ies of lectures given twice weekly in the fall term of alternate years; and an equal
ount of time devoted to the study of the botany of the forest flora of the region
r the university during each spring term; the instruction has been given by
of. A. N. Prentiss, holding the chair of botany and arboriculture.

he leading subjects presented in the recent lectures are: Forests generally con-
ered, and their relation to savage and to civilized life; the native forests of the
ited States; effects of forest removal; relation of forests to climatic conditions in
eral; forest denudation in the United States; forestry in Europe and European
estry schools; forestry in the United States; the Adirondacks and the proposed
rk of the State forestry commission; methods and practice in forestry.

ecently the university has planted a few acres of land, most of it exceedingly
ren, to forest trees, as an experiment in forestry, and, as far as it goes, an illus-
tion of forestry methods. The species chiefly planted are the Scotch Pine, the
hite Pine, European Larch, White Ash, Ailanthus, and Black Cherry. Some of
ese trees were grown from seed in the university gardens, the others being pur-
ased as seedlings of R. Douglas, Waukegan, Ill.

With the exception of abortive attempts to form a State forestry association,
thing of importance is known to have been done in the State by private interests
ter in the way of the protection of woodlands or the planting of forest groves.
Prof. A. N. Prentiss.)

Arbor Day was established by the legislature in 1887.

PENNSYLVANIA.

(7,000,000 acres woodland, or 24.3 per cent., of which 83 per cent. is in farms.)

The basis of Pennsylvania forests consists of broad-leaved tree especially oak, chestnut, and maple, with white pine and hemlocl and in parts pitch pine (*P. rigida*), interspersed, which latter con fers become more prominent, and form larger or smaller groves i the mountainous region crossing the State from northeast to soutl west. The White Pine is practically cut out, and the Hemlock, sti abounding in the northern portion of the State, is now the chief objec of the once extensive lumber industry of the State, and thus much tin ber stripped for tan bark is saved from rotting in the woods. Th hard woods have mostly been culled of their best timber, the remai der being poor in quality or coppice growth. Railroads already fin it necessary to go out of the State for their oak ties, and the minin industry in the once heavily-timbered coal regions has to import it props, etc., long distances; yet the secretary of State writes: "I deed, Pennsylvania is still well supplied with timber."

Although a good fire law has existed since 1870 for a few countie of the State (Schuylkill, Lehigh, Berks, Center, Snyder, Luzern and Union), providing for the appointment of firewardens and pay ment from the county treasury of expenses for the extinguishment c fires, and another law for general use, making the willful firing c woods a misdemeanor and compensating the prosecutor by the pay ment of $50 out of the county treasury as a reward, yet the observ ance and application of these laws seems wanting. Their effective ness, however, when applied has been demonstrated by the write when in charge of a tract of mountain forest fifteen miles in lengt which used to be constantly in danger of fire. At his solicitation th firewardens, hitherto unknown officers seemingly, were appointe and the effect has been immunity from fires for the last eight year

Still greater difficulties are met in enforcing the stock laws.

The last legislature (1887) passed an act for the encouragement c forest culture and providing penalties for the injury and destructio of forests. The first object is sought to be attained by a rebate c taxes, on a scale varying from decade to decade, for three decades o the planted or cared-for natural timber land. Since the sum so re paid to the forest planter does not exceed 45, 40, and 25 cents, respect ively, per acre, it is questionable whether this may be called encou agement and sufficient inducement for timber culture.

It is also doubtful whether the provisions for the prevention c fires are an improvement upon existing legislation, since they do nc provide any machinery for their enforcement; whether the dividin of the $50 penalty between the injured party and the school fund c the district, instead of the county treasurer, as before, is a greate incentive to enforce the law remains to be seen. At the last sessio of the legislature, also, the governor was authorized to appoint commission of five to examine into the question of forestry and re port at or before the next session of the legislature. This commis sion is authorized to report an act for the encouragement of forestry and it is to be hoped that only immediately practicable measures with the machinery to execute them, will be proposed.

A law allowing reduction of taxes for trees planted along high ways exists, and thus far is reported by the secretary of the boar of agriculture "to have been a disadvantage, the shade having a ba

influence upon the condition of the roads" (because proper road-making and drainage is not provided).

A State Forestry Association has been formed, and has started with zeal upon its work of changing the policy of the State and of its citizens in regard to their woodlands. Its membership of influential men and women in the first year of its existence has increased to nearly two hundred from all parts of the State. As an outgrowth, and forming branches of this association, county associations have been lately inaugurated in Delaware and Montgomery Counties. The occasional publication of Forest Leaves brings the news of the association and other interesting matter. A series of lectures has been given under the auspices of the association in the University of Pennsylvania, and much good influence is expected from this young but active organization.

Arbor Day was inaugurated in 1886, and well observed in 1887 in many parts of the State, the governor and the schools, under the lead of the State superintendent of public instruction, taking active and prominent part.

Neither the Pennsylvania State College nor any other educational institution in the State is doing anything for forestry that is worthy the name, "for lack of funds, but not lack of appreciation of the needs and importance of the subject," as Professor Buckhout, of the State College, writes. Under the Michaux fund, however, occasional lectures on arboriculture and forestry are given in the University of Pennsylvania.

Excepting occasional protection of second growth, no private enterprise in reforestation is reported, and wood-working establishments receive over half their supply of oak and hickory from other States.

NEW JERSEY.

(2,330,000 acres woodland, or 48.8 per cent., of which 30.4 is in farms.)

Over one-half of the woodland in the State represents such configuration or nature of soil as to make its clearing for agricultural purposes unprofitable. Very little virgin forest remains; two-thirds of the woodland is occupied by Pitch Pine (*P. rigida*) and cedar swamps, while in the northern part chestnut coppice is prevalent. The growth is such that if fires and wasteful practices are prevented natural reforestation easily recuperates the area cut over, and in twelve to fifteen years such forest becomes valuable for fuel purposes, ties, etc.

"The loss from fires for the last fifteen or twenty years, on a low estimate, has averaged $1,000,000 per year," an amount which would nearly pay the entire taxes in the State.

These losses occur in spite of a good fire law, enacted as early as 1792, which, like the New York law, constitutes justices of the peace, constables, and overseers of highways firewardens, with the right to order out the necessary help, etc. Railroad companies also are made responsible for fires occasioned by them and are bound to provide spark arresters for their locomotives. Here, again, it appears, for lack of proper central authority charged with looking to the execution of such laws, they have become nugatory. Some of the railroad lines are taking special precautions to prevent damages by sparks from locomotives.

The State geologist, from whose report some of the above informa-

tion is taken, has explored in detail the forests of the State and wi shortly issue a forest map with other information on the subject forestry. He also states:

"In our mountainous districts and in some portions of the souther and most thinly-settled parts of the State, the amount of forest lan is increasing, and there are a number of estates of several thousan acres each upon which the growth of timber is protected, thoug there is no systematic planting of trees, except in a small way."

Arbor Day, for the purpose of "forest-tree planting" by th schools, was established by legislative act in 1884, and the governo appoints usually two dates, to suit conditions of the season in th northern and southern parts of the State. No instruction in forestr matters seems provided in any of the State institutions.

DELAWARE.

(300,000 acres woodland, being 23.9 per cent. of total land area.)

The northern portion of the State has nearly all the agricultura land under plow, cleared of its former deciduous growth. Th southern portions contain the larger part of forest land, which i decreasing, mostly second-growth pine, with oak, poplar, and maple relegated to the unagricultural portions. The white-oak timber for which the State was celebrated in the times of wooden ships is mostly exhausted, although numerous small mills are still at work for ship and car lumber.

By a statute of 1827, which repealed all previous laws, any person setting fire to woodlands or marshes, except between the 10th day o March and the 1st day of May, and except to burn off clearings with due precautions, is liable to a fine of from $15 to $200 and to pay for resulting damages. There are some local stock laws also which incidentally give some protection to forests.

The census report places the loss from fire for the year 1880 at $15,67 (3,305 acres burnt over). Since property is taxed only on its rental value, woodlands are practically exempt from taxation, although they yield a fair income for local use, fire-wood being cut at the rate of about 200,000 cords per year, selling at $3 and $4 or less per cord.

No private interest or educational features are reported to exist.

MARYLAND.

(2,000,000 acres wooded, or 31 per cent., of which 81 per cent. is in farms.)

The northwestern portion of the State, which is crossed by the ridges of the Appalachian system, contains still on the inaccessible ridges some virgin growth of birch, maple, white pine, and hemlock. The region from the foot of the mountains to the shore of Chesapeake Bay is stocked with deciduous trees of great variety, mostly scanty growth or culled. Chestnut coppices are frequent in the southern counties. The sandy plains of the eastern peninsula contain a growth of pine (pitch pine), pure or mixed with deciduous trees.

The scrub pine (*P. inops*) seems to largely reforest the openings, gradually replacing the broad-leaved kinds.

Although the value of forest products in the State can not fall short of $5,000,000 and the loss by fires, largely from locomotives,

mounts to from $30,000 to $40,000 annually, "the people seem to hink there is no special need of legislative protection."

The soil and climate are such as to favor rapid tree-growth.

The malicious firing of woods is, under the statutes, finable to the xtent of $100, one-half of the fine going to the informer, the other alf to the county, besides allowing recovery of damages. No com-munal actions in regard to the forestry interests are reported, and no pecial care is taken to protect or improve nature's growth.

VIRGINIA.

(13,000,000 acres woodland, or 50.6 per cent., of which 70.2 per cent. is in farms.)

It is in this State that the change from Northern to Southern flora egins.

The three belts, running from north to south, into which Virginia nd the Carolinas and Georgia are usually divided, have each a haracteristic forest growth.

The tide-water belt of about 100 miles width along the sea-shore, vith its light, loamy, alluvial sand-(tertiary), forms the pine region f the State. The valuable Short-leaved Pine (*P. mitis*) is mostly re-noved and the less valuable pines, especially the Old Field Pine (*P. æda*) and the Jersey Pine (*P. inops*), take possession of the area. This second-growth pine furnishes a large amount of cord-wood for orthern shipments, yielding in thirty-five years at the rate of 70 ords to the acre and thus proving a valuable crop.

The Dismal Swamp in the southeast and other swampy portions f this region contain Bald Cypress, Red Cedar, both Sour and Sweet um still of large dimensions. Occasionally oaks and locusts are ound, and Sumach abounds on the upland.

On the drift of the Piedmont region (including the middle region), n undulating plain rising toward the western mountain ranges, and here intersected by many broken ridges, hills, and mountains, the ines first appear, mixed with various hard woods, especially black aks, which farther west predominate almost to the exclusion of ther growth. The area of abandoned fields occupied by the quick-rowing pines (Old Field Pine, and oftener Short-leaved Pine) is fast ncreasing in this region. Sassafras and Sumach abound.

The western mountain region, including the Blue Ridge and Ap-alachian Mountains, was originally covered with a heavy mixed rowth, in which oaks, hickory, chestnut, maple, black cherry, tulip rees, and other deciduous woods form the principal part; in some ortions hemlock, short-leaved and white pine are more or less bundant.

In the southwestern mountainous part of the State most valu-ble virgin hard-wood forests, with tulip and hemlock of large size, ill exist, having only lately become more accessible to markets.

The forest growth in many parts of Virginia suffered during the ar, and since the war the activity in getting out lumber, posts, and es especially, and peeling bark as a means of scanty subsistence by e impoverished population has done much to rapidly reduce the rgin forest and to leave it to inferior growth.

Tobacco planting in the southern counties leads to a reduction of rgin forest areas, new fields being opened and old ones left to the atural reforestation produced by the quickly-growing Old Field ines.

An estimate made in 1885, from a detailed account of railroad shipment, places the lumber production of the State, as far as the products are moved by rail, as follows:

122,085,441 feet B. M.	$1,831,28
33,666 cords fire-wood*	201,99
20,671,864 pounds sumach	206,71
Value at primary point of production	2,239,99

In 1880 the value of raw material for lumber manufacture alone was by the census placed at $2,173,727.

Eastern markets (New York and New England) take about 70 per cent. of the forest products.

A summary of the exports, as reported from different customs districts, exhibit the following result:

Boards, planks, etc. (1,253,000 feet)	$43,53
Staves, headings, shooks	423,37
Shingles (1,729,000)	11,50
Hoops and hoop poles	91,17
Other timber	388,04
Bark and tan extract	15,37
Total	973,01

Provisions of law against unlawful or malicious firing of woods have existed since 1802 (amended 1835), prescribing a fine not exceeding $100 or jail from two to twelve months, and also liability for damages.

Destruction of forest property to an extent of over $300,000 value was reported in 1880. A "no-fence" law, restricting cattle from roaming abroad, exists in some parts, mostly those denuded of fence material.

No other legislation or private interest in the subject or educational features, not even Arbor Day, is reported from the "Old Dominion" State, and the idea of fostering in any way an industry which represents not less than from $5,000,000 to $8,000,000 annual product has not occurred to any one.

The commissioner of agriculture, Hon. Randolph Harrison, writes:

"I regret to have to make an admission that no attention whatever is being paid to this most important subject; a reckless destruction of our forests is going on and no provision made for reparation.

"I think the time and the temper of our people are ripening for improvement in this and every other matter pertaining to agriculture."

NORTH CAROLINA.

(18,000,000 acres woodland, or 57.9 per cent., of which 77 per cent. is in farms.)

The larger part of the forests of the State is almost untouched. With this State we enter the rich Southern forest flora, or rather the territory where Northern and Southern flora dovetail, representing as it does the typical features of both Northern and Southern forests with nearly double the number of species that are found in the Northern forest. We also enter here the great lumbering region of the South, based mainly upon the supply of Long-leaf and Short-leaf Pine (Yellow, Georgia, Pitch Pine) and the production of naval stores in which formerly this State had a monopoly of great importance.

* Probably an overestimate of value.

The Long-leaf Pine gives character to about one-third of the forest area; the oaks (nineteen species, including the Eastern Oaks of importance) dominate not less than two-thirds.

The Hickories (7 species) occur in abundance and of large size, and Walnut, Black Cherry, and Sugar Maple have been quite common; also Chestnut and Tulip trees and a variety of other deciduous trees.

The same general subdivision into three belts, like that given for Virginia, is applicable.

The level coast region (120 to 150 miles wide), with preponderant pine growth, formerly mainly Long-leaf Pine, and on the less well-drained portions and stiffer soils Short-leaf Pine, now largely superseded by Old Field Pine of poor quality, where also the Live Oak, Holly, and Palmetto may be found. The swamps and lowlands, very frequent between the mouths of rivers and around the margins of lakes, are occupied by the Bald Cypress, forming almost the exclusive growth of several square miles.

The Piedmont hill country, gradually rising westward, of 200 miles width, contains hard woods, mostly culled of the better timber and with Old Field Pine encroaching. The mountain region, a plateau 2,000 to 3,000 feet above sea-level, the highest in the Eastern States, of 30 to 50 miles' width, between the Blue Ridge and Smoky Mountains on the east and the Appalachians on the west, bears a heavy, most diversified, and but little touched hard-wood growth, to which the northern White Pine (in some localities in considerable quantity) and Hemlock are added.

The unmethodical overworking of the pine for turpentine is the greatest damage done to the forests. Forest firing in the spring, for the supposed improvement of the grazing, "which has been long since extirpated," is a usual practice, as everywhere in the South. Carelessness gives also rise to many fires, which deteriorate the soil and young growth and occasionally the standing timber.

The lumber product of Long-leaf Pine for 1885 was placed at over $1,000,000, and the value of naval stores at $1,320,429.

The export by sea to foreign ports for 1885 comprised the following items:

Naval stores	$1,078,602
Boards, planks, etc. (14,926,000 feet)	239,193
Shingles	22,468
Staves and headings	1,080
Total	1,341,343

The Naval Store industry has decreased 30 per cent. in the five years since 1880, the production during these years having necessitated the invasion of nearly half the long-leaf pine forest of the State.

The State owns at least 200 square miles of swamp lands, partly with a growth of cypress and gum and other valuable woods.

In the little hand-book on the Woods and Timbers of North Carolina prepared by Mr. P. M. Hale in 1883, giving much valuable information, he says:

> The intrinsic value of this heritage alone is such that within ten years it will be seen that it exceeds the present total valuation of the entire property of the State.

There is no provision of law in the interest of forest property later than the act of 1777 (amended in 1782), which forbids to any but owners the firing of woods and requires that notice of the intent to

fire shall be given to neighbors and that spread of fire upon vacant lands must be prevented.

It should not be overlooked that the former Commissioner of Agriculture, Hon. Montford McGehee, recognizing that this great business interest of the State ought to receive more considerable attention, exerted himself in teaching his people the significance of the forests, through the medium of occasional forestry articles in his monthly bulletins. Perhaps as an outgrowth of these exertions, a course of instruction on the subject of forestry has been instituted at the University of North Carolina, by Prof. J. A. Holmes.

SOUTH CAROLINA.

(About 13,000,000 acres forest, or 67.3 per cent., of which 55.8 per cent. is in farms.)

The general physiographical features of the State and its forest growth correspond to those of southern North Carolina and Georgia, except that the forests, being less accessible, or the rivers with their swampy borders not being favorable to rafting, have preserved more of their virgin stores. The coastal region may be divided into the coast region proper, of 10 miles width in the average, here and there bearing a stunted growth of live oak and palmetto; a lower pine belt, or savannah region, with a widtlr of 50 miles; an upper pine belt, varying in width from 20 to 40 miles; and the geographically more confined hill region.

The characteristic growth of the uplands ("pine barrens") in the first belt is the Long-leaf Pine in open woods, without any undergrowth except here and there a scrub oak. The overflowed lands (4,500 square miles) contain in the most elevated parts a thick but small growth of cypress, the lower portions being covered by a thick, heavy growth of magnolia, sweet and black gum, tulip, also white oak, black walnut, elm, hickory, and especially bald cypress of large size. This is the lumbering region of the State, turpentine orcharding being the principal business, outside of swamps comprising nearly 3,000 miles of forest. The upper pine belt is characterized by the admixture of undergrowth of various oaks and hickory in the long-leaf pine forests of the uplands and the absence of overflowed swamps; the upland swamps along the rivers, bays, and river bottoms, about 1,000 square miles, being occupied by cypress, white oak, gum, elm, hickory, black walnut, and, in addition, ash and beech. Turpentine pine timber, cypress shingles, and oak staves are cut here in large quantities. The forest area outside of swamps contains about 3,500 square miles. Abandoned fields grow mostly in short-leaf pine. The characteristic growth of the Red Hill region, (1,620 square miles, of which 1,400 in forest), is oak, hickory of specially large size, and the short-leaf pine replacing the long-leaf. The Sand Hill region stretches from Augusta to Chesterfield, with average width of about 20 miles, containing nearly 2,000 square miles of forest, with a heavy growth of long-leaf pine, which, near its northern limit, reaches its greatest perfection in size and quality. In the Piedmont region the original heavy hard-wood growth has almost entirely disappeared, and is replaced by the short-leaf pine, with varieties of oaks of small growth and hickories; on the abandoned fields sometimes by the Old Field pine (*P. tæda*). The former prairie-like valleys have become covered with a growth of heavy post oak and black-jack oak and sometimes of red cedar. Chestnut and chestnut

oak, formerly luxuriant, are said to be dying out. Along the water-courses heavy-sized timber of great variety is found.

Of the 10,425 square miles of this region 50 per cent. is in woodland and 22 per cent. in old fields covered with Short-leaf or Old Field Pine. The mountain belt, (1,200 square miles, of which 80 per cent. is woodlands), has, with a great variety of other woods, oak, chestnut, and short-leaf pine as the prevailing growth almost undisturbed, with white pine and hemlock at the highest elevations.

The accessible merchantable pine of the coast belt and hard wood of the middle region are mostly removed.

The lumber industry, mainly developed in the lower third of the State, taking during the census year third rank in the State and producing 13 per cent. of the lumber in the United States, had become the leading one in 1885, the product of the saw-mills being valued at $6,236,6.7, mainly yellow pine and cypress and rough staves and shingles. Over one-third of the tar and turpentine products of the United States come from this State, representing a product valued at $2,912,271.

These figures show an increase over those of the census year 1880 of more than 200 per cent. in the lumber manufacture, and 50 per cent. in naval stores. There were shipped through or out of the State over the railroads in 1885, 73,003,638 feet B. M., 16,922 cords of wood (9,307 coming from outside), and 175,534 barrels of naval stores, 7,499,960 shingles and staves (5,624,970 from outside), and 4,118 of other forest products. In the same year the foreign exports by water show over 9,000,000 feet of boards, deals, and planks, nearly 2,000,000 shingles, and the total value of exported forest products $1,198,657, of which nearly $1,000,000 is represented by naval stores in the shape of 218,979 barrels of rosin and 44,090 barrels of spirits of turpentine.

According to the replies received from Hon. W. Z. Leitner, Secretary of State, "the laws in regard to forest fires are adequate (act of December 21, 1857, directed against willful and malicious firing only) and sustained by public opinion; they are duly enforced and further protective legislation is not needed."

Yet in the census year 431,730 acres, causing a loss of $291,225, were reported burned over in the pine belt, and the damaging effect upon the future of these pine forests from the annually recurring fires is made evident from the account given for this State.

Stock laws exist for the State, with the exception of the counties of Williamsburgh, Georgetown, and Berkeley, where portions of the county are exempt from the operation of the law. No special attention to the future condition of this growing and important interest in the State is reported.

GEORGIA.

(18,000,000 acres forest, or 47.7 per cent., of which 84.8 per cent. is in farms.)

In contour and geological formations similar to the Carolinas, we can discern the coast region, with its long-leaf pine belt covering the tertiary deposits of nearly the southern half of the State (19,000 square miles) with a strip of live-oak growth near the coast, 100 miles long by 15 miles and the usual almost inaccessible cypress swamps along the rivers; then follows a narrow strip on which the long-leaf pine is gradually replaced by the short-leaf and loblolly pines, and in the middle northern counties the oaks and hickories are

prominent with other hard woods and pines intermixed; cedar occupies largely the limestone formation in valleys and on mountain sides and on the higher elevations in the northeast white pine and hemlock (?) reach their southernmost range.

The northwestern corner contains an excellent white oak region, covering about 500 square miles; a small body of long and short-leaf pine is also noted along the Coosa River and continued into Alabama.

The product of the lumber industry in 1885 was valued at $7,591,460, or an increase of nearly 60 per cent. over the census year, while the export in naval stores has about quadrupled. In the production of the latter, Savannah, Ga., takes the lead.

Incomplete returns from Brunswick, Darien, and Savannah place the foreign and domestic export of lumber for 1885 at near 24,000,000 cubic feet, mostly lumber, valued at over $3,000,000, and the naval products at 766,699 barrels of rosin, worth round $2,839,770, about one-half of which goes to foreign countries, and 143,328 barrels of spirits of turpentine, worth nearly $3,000,000.

The unsystematic and careless manner of turpentine orcharding rapidly reduces the value of the old forest growth, while the annual firing surely but slowly destroys the future of this natural source of wealth, burning out the leaf mold and killing the seedlings of the better kinds, without improving but on the contrary deteriorating the pasturage by killing the finer and more nutritious herbage.

There exists on the statute book legislation against willful or malicious firing of the woods, (laws of Georgia, 1833), and in 1847 the firing of woods without notice to adjoining occupants, excepting between March 1 and May 1, was forbidden in the counties of Camden, Glynn, McIntosh, Scriven, Jefferson, and Washington.

Lately some interest in the protection of the forest property of the State has prompted the introduction in the last legislature (1887) of a bill for the appointment of a forest commissioner, and containing proper provisions for the furtherance of the forestry interests in the State. Hon. C. R. Pringle, speaker *pro tempore* of the State senate, the author of this bill, has labored for the cause of rational forest management and, as president of the American Forestry Congress, meeting in Atlanta in 1888, may be said to stand at the head of the reform movement in forestry matters in the South.

FLORIDA.

(20,000,000 acres, or over 57 per cent., covered by tree growth.)

In the main this State is flat and sandy in character, except in the Appalachicola River region, which is an undulating hill country, corresponding to the Piedmont region in soil conditions and in forest growth, the latter representing the southern limit of the northern deciduous forest flora following the Appalachian range. The valuable timber of its luxuriant hard wood forests is almost untouched, except where removed to gain farming lands. From this elevated portion, about 300 feet above sea level at Tallahassee, and from the slightly elevated "backbone ridge," a limestone formation running down the center of the peninsula with a width of 50 miles, stretch to the west and east the low lands with a growth of long-leaf and Cuban pine, frequently interspersed with the so-called hummocks, elevations of rich soil bearing a luxuriant growth of oaks, live-oaks, and

other deciduous trees, and with swamps covered by forests of cypress, red cedar, gum, and on their borders broad-leaved evergreens like the magnolia, bay, etc. The pine woods are mostly very open, often hardly deserving the name of forests, and without much undergrowth, except the shrubby black oak, and become of less value going south. After the 29th degree of latitude is passed the long-leaf pine deteriorates in size and quality, although ranging as far south as the 27th degree, while the Cuban pine, an almost or quite as valuable tree as the long-leaf, yielding good timber and naval stores, along the coast at least, is found of available size and quantity much further south. This tree, reproducing itself more easily and being less dependent upon soil conditions, promises to replace the long-leaf pine in the future.

The interior of the southern part of the peninsula, containing the Everglades, is little explored, but is said to contain large cypress swamps. The pine lands of western Florida, occupying a narrow strip along the coast, are surrounded by marshes and swamps, rendering them difficult of access.

The pencil cedar (*J. Virginiana*) grows to large size in the swamps of middle and northern Florida, but the accessible most valuable timber is growing scarce.

Along the shores of the bays and creeks and on limestone hummocks and keys south of Tampa Bay the semi-tropical trees of the West Indies make their appearance, and some eighty species of hard woods, valuable in quality but deficient in size and quantity, are found. The greater part of the State, especially of the southern half, is unsettled. The accessible pine and cypress of the northern peninsula is fast disappearing, especially around the main lumber centers, Jacksonville and Pensacola. Much of the lumber passing through the latter place comes from Georgia and Alabama forests. Shipments from Jacksonville have decreased 33 per cent. since 1880 (38,278,538 feet B. M. in 1885, as against 58,837,451 in 1881), without corresponding increase from other parts, while Pensacola shipments have remained nearly stationary with about 20,000,000 cubic feet.

The aggregate value of exports of lumber and timber in 1885 amounted to round $2,500,000, representing about 18,000,000 cubic feet; the total value of lumber sawed in 1880 is placed by the census at $3,060,291.

Fires, as everywhere in the Southern States, annually eat up the scanty leaf-mold, and the agriculturist clearing the pine barrens must pay for this at the rate of $12 to $15 per acre in fertilizers.

There exists on the statute book legislation against willful and malicious firing, but it would be difficult in the sparsely settled country to enforce any law that is not supported by the intelligence of each single citizen. Education in this respect is needed first of all.

Lately, through the exertions of the Southern Forestry Congress, meeting twice at De Funiak Springs, Fla., the subject of forest protection has received an impetus, and the presumption is that the next legislature will take steps in this direction.

Florida has observed Arbor Day since 1886, Governor Perry designating the day by proclamation and urging heartily its observance, especially in connection with the public schools. Reports from seventeen counties of the State show that 19,186 children, or more than one-fifth of the school population, united in the celebration of the day.

ALABAMA.

(17,000,000 acres, or 53.1 per cent. woodland, of which 59.6 per cent. is in farms.)

The drift deposits of the sandy coast plain and rolling uplands in the southern part of the State are occupied by the long-leaf pine, which here grows in perfection, except the stunted growth on the wet savannas nearest the coast, and where the Cuban and Loblolly pine occupy the richer, moister soils of hummocks and river bottoms almost exclusively. With the appearance of the tertiary strata, about 100 miles from the coast, a mixed growth of oaks and various pines, short-leaf and Loblolly, is associated with the long-leaf pine, with patches exclusively of the latter on the drift-capped ridges and open oak woods interspersed. In this lower section extensive cypress swamps border the rivers. Going northward hard-wood forests, mainly oaks, with belts of short-leaf pine, cover the rolling country, and upon the limestone formation of the Tennessee and on the northeastern foothills of the Alleghanies the pines are almost entirely absent, except on the sandstone ledges, but a varied hard-wood growth of oaks, hickories, ashes, walnuts, cherries, poplars, etc., abounds. There are found in the northern half of the State isolated bodies of the long-leaf pine on the drift deposits along the Coosa River and in Walker County; also a belt of the same species on the gravelly hills across the State between the 32d and 33d degrees of latitude, 10 to 30 miles in width, interrupted only by the strips of deciduous trees which occupy the bottom-lands along the streams. This belt bends northward near the western border and gradually changes into short-leaf pine.

The long-leaf pine, in its timber and naval stores, furnishes the bulk of the forest products, which in increasing ratio are shipped from the State, besides a considerable consumption of hard woods for railroads, cooperage, and domestic purposes.

The foreign export trade of wood and its manufactures from Mobile, which is the great distributing point of the State, in 1885 included of pine lumber, 1,210,000 cubic feet; hewn timber, 1,140,791 cubic feet; sawn timber, 1,832,036; or together over 4,000,000 cubic feet, valued at over $500,000, while the total pine lumber product of the State for 1885 is placed in value as $7,991,368, or three times that of the census year, representing not less than 65,000,000 cubic feet of wood.

According to the carefully compiled statistics of Dr. Charles Mohr, of Mobile, the only rational, though conservative, computations in existence, and so far invalidated only by the unsupported assertions of certain lumber papers, without any basis, there were cut during the years 1881–'85 of long-leaf pine alone 105,0 0,000 cubic feet, and remained standing in 1885 about 1,500,000,000 cubic feet of merchantable timber of this description.

The value of naval stores produced in 1885 in Alabama is placed by the same writer at $851,600, somewhat over 50 per cent. more than in the census year.

The same writer, most conversant with the forest conditions of the Gulf States, and whose various writings on the subject belong to the most instructive forest literature of the country, deplores the reckless and wasteful manner in which the turpentine orcharding is carried on in the State, dooming a large portion of the valuable pine growth to useless destruction before it can be utilized for timber.

In general only total absence of interest in the protection and more rational utilization of the enormous timber wealth of the State can be reported, although various laws to check the annual firing of the woods, apparently little observed or enforced, encumber the statute book.

An act of 1852 against willful and negligent firing of woods provides fines, and the willful burning of turpentine orchards was made an indictable offense in 1856, or, if the fire was set by carelessness or inattention, a misdemeanor. In 1868 a law, for Coosa County alone, made campers liable for damages from their fires.

In 1873, the burning of woods within five miles of coaling grounds in Jefferson and Tuscaloosa Counties, was made punishable by a fine not exceeding $5,000 or imprisonment not exceeding ninety days. In 1875, the setting of fires to woodlands in Washington County, that cause injuries beyond the owner's premises, was made punishable by hard labor for not less than three nor more than six months; but in 1877 this act was repealed and only the willful firing of woods on inclosed lands of another remains punishable.

It is to be hoped that the meeting of the Southern Forestry Congress in Huntsville in 1887 may have awakened some thought in the community of the desirability of utilizing the enormous forest wealth with more regard to a continuance of the valuable revenue which it yields.

MISSISSIPPI.

(13,000,000 acres, or 44 per cent., in forests.)

The general location and make-up of forest areas in this State is similar to that of Alabama. The maritime pine belt of long-leaf pine, forming the bulk of the forest areas on the southern lower drift above the extensive marshes and tidal swamps, comes, however, to a termination at from 25 to 40 miles east of the Mississippi River, but reaches farther north at its northwestern terminus, (above 32d degree). The mixed pine growth on the hill-land, following northward, occupies only a confined triangular section entirely on the Alabama frontier, and is continued northward in a narrowing strip nearly to the northern boundary, in which the long-leaf pine is absent and the short-leaf pine prominent. The central belt of short-leaf pine found in Alabama enters Mississippi in the northeastern corner.

The remainder of the State, outside of the small areas of prairies and the farm land, bears a hard-wood forest of white oaks, ashes, sweet and black gums, hickories, black walnut, tulip trees, sassafras, etc., which in variety, quantity, and quality is rarely equaled, but the products of which, for lack of accessibility or development, do not find as yet a ready market, while large quantities of the finest timber of oak, hickory, and walnut is deadened to furnish agricultural land. In the swamps of the Yazoo delta and the rich bottom-lands of the Mississippi and Pearl Rivers, this growth attains the noblest proportions and forms a prominent and valuable part of the forest.

The pine timber along the coast and the accessible rivers is mostly removed, and is there replaced by the Cuban or Loblolly pine, while the abandoned fields and clearings farther north are occupied mainly by the short-leaf pine.

The turpentine industry is but little developed in this State, which accounts for the less wide-spread devastation of the pine woods, but

the production of naval stores is expected to increase with the opening of railroad communication.

The lumber business is said to have developed in an increased ratio during the last few years, but statistics are absent, except the statement by Dr. Mohr, of the cut of long-leaf pine. The cut during the five years 1881–'88 is placed at 824,000,000 feet, leaving over 17,000,000,000 feet untouched.

The shipments from Pascagoula, the main lumbering point, amounted in 1885 to 167,839,801 feet, while the total product of the State during the year is placed at 241,133,800 feet, valued at round $2,500,000. Other reports place the value of logs and manufactured lumber of all kinds at nearly $4,000,000, of which $440,000 worth was exported.

The Louisville and Nashville Railroad alone moved over 6,000,000 tons of forest products during the year 1885.

The laws of the State provide that any person convicted of willfully setting on fire any woods, marshes, or prairies so as to occasion loss or injury to others shall be liable to a fine of from $50 to $500, and a fine of $100 when no private injury results from the firing. The person is also liable to a civil action for damages. The law, however, allows fires to be set on wild, unappropriated land between the first day of February and the first day of May, and the burning of brush and rubbish on plantations at any time.

The census reports forest fires consuming 222,800 acres during the year 1880.

LOUISIANA.

(13,000,000 acres woodland, or 44.6 per cent., of which 35.1 per cent. is in farms.)

The forest growth of this State is largely pine, yet the inroad made into the immense stores is almost imperceptible. The maritime belt of the long-leaf pine continues, as in Mississippi, to within 30 or 40 miles of the Mississippi River, with a partial extension of short-leaf pine, mixed growth, 15 or 20 miles farther, on the hills bordering the river basin. This belt is continued on the western side of the river-bottom lands towards the Texas line, diminishing as it extends northward. The long-leaf pine occupies the drift gravels below the Red River, and is here of good growth but inferior quality, and on the sand-drift hills above the river is of excellent quality; while the short-leaf pine, mixed with oak and hard wood of various descriptions, a vast primeval forest, occupies the northern hill country, the short-leaf pine attaining here the finest proportions. The alluvial deposit of the Mississippi and the broad river bottom of the other streams flowing through this pine region are characterized by a luxuriant growth of white and black oak and other hard woods, as white and green ash, pecan, persimmon, sycamore, sassafras, magnolias, and bays, while the swamps contain as usual the cypress and gums. The coast line is more or less treeless, the swamps containing a poor growth of cypress.

Along the coast of eastern Louisiana the pine has been largely removed, but in general, although the natural facilities of water transportation are excellent and railway communication not lacking, the development of the vast forest resources of the State, the standing pine of which alone was estimated at over 48,000,000,000 feet, has only recently begun with the influx of Northern capital. The cut of long-leaf pine is placed by Dr. Mohr at 84,300,000 feet, or 20 per cent.

above that of 1880, and the naval stores yielded 55,863 barrels, mostly from eastern Louisiana. The value of the lumber trade in 1885 was estimated at $2,715,000, while the foreign export in 1886 amounted to $737,449. In New Orleans there were handled during that year nearly 7,000,000 oak staves and over 9,000,000 cypress shingles, and the six railroads of the State moved 50,000,000 tons of forest products. Even so insignificant a forest product as the long tree moss, prepared for upholsterers, is said to represent an annual value of $100,000.

Various causes have protected the forests of Louisiana from damage by fire, among which are the absence of turpentine orcharding in the western portion, the scarcity of settlements, and the frequent interruptions of the pine forest by deciduous growth. There is only a law prohibiting the firing of woods during the months of April and October in the parish of Winn. No special interest in forestry has been reported, save a few attempts at forest planting in the southernmost treeless prairies.

TEXAS.

(40,000,000 acres under forest, or 23.2 per cent.)

The entire forest area worth the name is confined to the eastern part of the State.

The western limit of the long-leaf pine is reached at about the 95th degree of longitude. Beyond this the loblolly pine united with hard woods continues for 50 or 60 miles westward, while north of these the rolling ridges are, as in Louisiana, occupied by the short-leaf pine, more or less interspersed with oaks. The swamps along the large streams flowing through the pine region contain a cypress growth which is said to be inferior in quality. The main body of the Atlantic timber belt reaches, with open forests of stunted post oak and black jack and other oaks, westward of the 95th degree of longitude, where it ends almost abruptly, coinciding with the line of geological formation, where the limestone appears. Two narrow belts, 20 to 40 miles wide, of open oak woods extend from Wichita each 140 to 150 miles southward, occupying a gravelly deposit, at the southern end of which a tract of 90,000 acres is covered with now mostly second-growth loblolly pine.

Beyond the Brazos River forest growth proper ceases, although tree growth continues, especially along the river bottoms, which near the Gulf coast are very wide and are covered with dense forests of enormous trees. Farther west the bottoms gradually narrow, the number of arborescent species covering them decreases, and the individual trees are small and "stunted." West of the Colorado River the stunted mesquit on the plains and western cedar growing on the limestone hills are of importance as furnishing the only wood supply, while the outlying ridges of the Rocky Mountains, in the northwestern corner, bear a stunted growth of western pine and cedars mixed with oak species of the Atlantic region.

When it is taken into consideration that three-fourths of the State is treeless, or at least devoid of the wood supply which is needed for an increasing population, and that the territory north and west of the State is in the same condition, it would appear that the State should have an interest in the manner in which these resources are utilized with respect to future requirements.

Although nearly 600,000 acres of woodland were reported as damaged during the census year, such damage does not seem to be usu-

ally experienced. The law punishes willful burning of woodlands and prairies by a fine of $50 to $300, and makes also the person from whose land fire is communicated liable to such a fine.

The tree-planting interest, which in treeless plains naturally is gradually developing, has given rise to the formation of a State Forestry and Water Supply Association within the last year. The Texas State Horticultural Society (Mrs. J. R. Johnson, Dallas, secretary) is also devoting its attention to these interests.

MICHIGAN.

(14,000,000 acres woodland, or 38.1 per cent., of which 31.8 per cent. is in farms.)

The forests of the lower peninsula, as much of them as remains, consist of broad-leaved trees, among which the white oaks are prominent, and but little white pine is intermixed. Beyond latitude 43° the admixture of pine is increasing, and where the lumberman's ax has not yet touched it the pine occurs also in pure stands, occupying sandy and gravelly ridges and the sandy plains in the northern peninsula, while the lower ground is occupied by hard woods like sugar maple, ash, beach, oak, and the not unfrequent swamps abound in tamarack and yellow cedar (*Chamæcyparis sphæroidea*) of large size.

Several large tracts of sandy barrens occur in the central and northern parts of the lower peninsula, on which the gray pine (*P. Banksiana*) forms the characteristic growth, with birches, poplars, and scrub oaks intermixed, altogether of stunted growth.

The hard-wood forests of the twenty southern counties, with about 90 per cent. of the land in farms, are more or less reduced to a state where they can hardly furnish the needed home supply.

The white pine, which has furnished its lumber for the last fifty years, is said to be largely removed in all but the less accessible localities. It is estimated that not more than 20,000,000,000 feet of merchantable lumber remain standing.

The lumber industry in this State within the last thirty-three years, has developed in a remarkable manner. The aggregate value of the white pine product during the last twenty-five years approximates $870,000,000; the product, which in 1864 was valued at $8,372,550, in 1884 amounted to more than $67,000,000 worth, while nearly $50,000,000 capital is invested in this branch of forest production alone. Of the white pine product of the United States in the year 1887, Michigan furnished the lion's share (nearly 60 per cent.) with round 4,400,000,000 feet and 2,800,000,000 shingles, valued at round $65,000,000.

From the State census of 1884 the following interesting table has been constructed:

Manufactures.	Number.	Capital employed.	Number of employes.	Wages paid.
Using wood entirely—				
Crude	2,119	$59,571,969	52,347	$18,516,605
Finished	668	14,561,160	14,009	5,011,019
Using wood principally	768	9,793,534	8,513	3,485,326
Total	3,855	83,926,663	74,869	27,012,950
Ratio to other manufactures (per cent.)	40	61	60	61

The value of cord-wood from farm forests (5,522,472 cords) cut during the year is placed at $8,898,528.

Although there exists a territorial law of 1817, revised in 1846, making willful and negligent firing of woods a misdemeanor, and although the statutes make the extinguishment of fires a duty of justices of the peace, supervisors, and commissioners of highways, and make the refusal of any citizen called upon to aid in their extinguishment punishable by a fine of from $5 to $50; although also the liability of railroad companies with reference to fires originating from locomotives was established by legislative act of 1873, yet the annual losses by fire are enormous. While this loss in the census year was placed at near $1,000,000, various estimates place the same at from $7,000,000 to $12,000,000 worth of standing and cut timber. Roadside tree-planting is accepted in lieu of a certain amount of road tax.

The first public step in the direction of a more rational attention to this great interest, upon which the prosperity of the State has been based and upon which two-thirds of its manufactures rely, has been lately taken. The State board of agriculture was by act of legislature constituted a Forestry Commission for the purpose of formulating the needed legislation.

A forestry convention for the purpose of hearing various interests on the question involved was held in Grand Rapids early in 1888, and the State is being canvassed by the Commission to obtain the needed information upon which to proceed, the supervisors being charged by law to report forest conditions and forest fires occurring in their districts.

The professor of botany at the Agricultural College has also the title of professor of forestry, but his various duties in other directions "have not allowed him to give much attention in particular to this branch of studies." Yet a class of twenty-five seniors received lectures on forestry for twelve weeks, daily, of which Professor Beal says: "I was gratified and rather surprised at the interest taken." An arboretum at the college forms a desirable means of practical instruction. Arbor Day was established by law in 1881.

WISCONSIN.

(17,000,000 acres woodland, or 48.8 per cent., of which 28 per cent. is in farms.)

The southern portion of Wisconsin belongs to the great central prairie region, constituting its northeastern portion. This part of the State is characterized by oak openings on the uplands and belts of oaks along the river bottoms. Occasionally other hard woods, such as maple and beech, are found. The settlement of this region, checking the prairie fires, has allowed the natural forests to spread, so that there is now more timber in southern Wisconsin than there was when it was first opened to settlers. Originally the central part of the State, north of a line across from Milwaukee to the Saint Croix Falls, was covered with a dense forest of hard woods, oaks, ash, maple, cherry, birch, and the other trees of the northern forest, through which, upon the sandy or gravelly ridges, great bodies of white pine were scattered, now mostly culled. Northward the hard woods form a smaller part in the composition of the forest, and while the pine decreases in quality and productiveness, swamps of tamarack, cedar, and spruce, and considerable tracts of barrens decrease also the area of valuable growth. Along the streams and for some distance from

them the pine has been mostly removed, and only the opening of less accessible districts by the building of railroads has made it possible to supply the market. The white pine product, which is not easily separated from that of Minnesota, for 1887 amounted to round 1,800,000,000 feet and 800,000,000 shingles, or somewhat less than 25 per cent. of the total white pine cut. In the progress of settlement in the central and northern portions of the State the hard woods are often destroyed simply to clear the land for cultivation, and where the forests have not been entirely removed the best timber has been taken, and there is reported "a general deterioration and scarcity of the best varieties of hard wood, and the substitution of beech, elm, and other woods for oak." In portions of the State there is considerable hemlock mingled with the pine, which, with diminishing supply of the latter, is more appreciated and is for many uses supplanting it.

Forest fires have been very destructive in Wisconsin, owing very much to the wasteful method of lumbering which has prevailed here as in the neighboring States, Minnesota and Michigan. Only the largest cuts from the trees have usually been taken, while the tops, limbs, and even considerable portions of the trunks have been left in the forest, where they soon become dry and ready to kindle by a spark, and furnish the means of starting a wide-spread conflagration. More than 400,000 acres of woodland were reported as destroyed by fire in the census year 1880. Yet the secretary of state says that the laws of Wisconsin in regard to forest fires are "adequate to secure their purpose." They may be adequate so far as form and phraseology are concerned. But no laws, certainly no laws of this character, will be effectual or of any value if not sustained by public opinion and enforced by proper authority. The statutes provide a fine not above $500 for willful, malicious, wanton firing of prairies or woodlands during the months of August to November, or for negligence in letting fires run beyond one's land to the injury of another. Stock laws exist, but are optional with the towns. A bounty for tree-planting of $2 per acre annually is paid after the trees are 12 feet high. Before that time lands planted with trees may be exempted from taxation under certain conditions. The secretary of state says: "My impression is that few, if any, have fulfilled the requirements necessary to receive this bounty or exemption."

MINNESOTA.

(30,000,000 acres woodland, or 59.3 per cent., of which 6.8 per cent. is in farms.)

This estimate of the forest area is probably too high, since only about 33,000,000 acres of the land area of the State contain natural forest growth, while about one-third of the State is prairie land. A more conservative estimate places the actual timbered land at 16,500,000 acres, and the groves and fringes of trees along the water-courses as covering an additional 6,000,000 acres. The southern and western part of the State is prairie, with the usual growth of broad-leaved trees along the water-courses. The main body of the valuable forest cover, on another third of the State skirting the prairie to the north and east, consists of hard woods (some three and a half million acres without conifer growth, mainly oaks, sugar maple, poplar, etc.), which towards its northern limit was mixed with white and red pine, now largely culled out. The pines become more abundant but less valuable farther north, and the valuable hard wood is absent, except for some distance along the shore of Lake Superior,

where also the bulk of the standing pine is to be found. In the central region more or less extensive tracts of barren land covered with an open growth of stunted birch, scrub oak, and gray pine are frequent. Of the most northern portion of the State beyond the Mississippi divide, but little is known, except that it abounds in swamps covered with tamarack, spruce, and white cedar, lakes, and rocky ledges. Its productive capacity is not large and the northern part of the State is not adapted to lumbering operations.

Although largely culled of the most valuable pine, the State continues, together with Michigan and Wisconsin, to furnish the bulk of the white pine lumber of the market. The cut for 1887 of this lumber in the State amounted to round 1,500,000,000 feet and 500,000,000 shingles, or somewhat less than 20 per cent. of the total pine product. To produce such amounts probably not less than 400,000 acres of average growth must be cut over, while the entire forest area containing white pine in the State, not culled over, covers at best not more than 10,000,000 acres. The Indian reservations, mostly unsurveyed, are estimated to contain 1,000,000,000 feet of pine, in addition to a considerable amount of hard wood. This is being drawn upon more heavily every year and efforts are being made to open the entire area for the market.

The hard woods are to a considerable extent utilized for railroad timber and other purposes.

Fires do perhaps less damage on account of the frequency of lakes and swamps, yet in the census year losses estimated at $1,395,110 were reported.

By the provisions of the act of 1858, and its amendment in 1860, any one willfully or negligently setting fire to any grounds whatever is liable to a fine of from $5 to $100, and in default of payment to imprisonment of from one to three months.

The treeless condition of the best agricultural lands of the State early called for measures to encourage tree-planting in these sections. An act was passed in 1871 "to encourage the planting and growing of timber and shade trees."

Arbor Day was instituted by the State Forestry Association (one of the earliest of such associations) in 1876, and on the day first designated, as appears by the assessors' returns, 1,500,000 trees were planted. The day was legalized by the legislature in 1881. The State also appropriated to its Forestry Association, for the years 1883–'84, $5,000 to enable it to publish its manual of tree-planting, to secure lectures, and the experimental cultivation of trees, to distribute trees and tree seeds, to give information as to the best method of preventing forest fires, etc., but as only $1,500 of the sum appropriated was expended during the specified years, under a ruling of the State auditor, the balance unexpended was returned to the treasury of the State. The manual has been carefully prepared and has been of great practical use, not only in Minnesota but in the neighboring States (C. L. Smith, secretary, Minneapolis). It is estimated that there are now from 50,000 to 60,000 acres of planted forest in the State.

OHIO.

(4,258,767 acres of woodland, or 16.69 per cent., of which 98.6 per cent. is in farms.)

According to the report of the secretary of state the forest area has decreased within fifteen years 21.52 per cent., while during the same period the unimproved (not forest) land has increased 24 per

cent. The assessors of taxes, being obliged to report the acreage o woodlands annually, since the year 1873 Ohio presents the best sta tistical material for studying the gradual decrease of the hard-wooc forests which formerly covered the rich table lands and hills of Ohic and of the Middle States, containing oak, chestnut, maples, ash, wal nut, hickory, tulip-tree, etc.

A detailed account of the forest conditions in each county is con tained in the first annual report of the Ohio State forestry bureau (Adolph Leue, Cincinnati, secretary) for 1885:

The original forest has been removed except from Ottawa, Miami, Montgomery, and a few western counties and lands unfit for agri culture; the balance is second growth.

There is now reported from various points a disposition to utilize the timber in a more economical manner. The cooperage industry is perhaps the most thriving industry using forest products in the State. Much carriage and ship timber is exported, while much of the second growth is cut for railway ties.

The law of February 11, 1805, makes the willful or negligent firing of woods an indictable offense. Seventy-four thousand one hundred and fourteen acres of woodland were reported burned in the census year 1880, valued at $797,170. The first associated effort to arouse the people of the United States to the necessity of considering and reforming their forest policy originated in Cincinnati in 1882, by the formation of the American Forestry Congress. The idea of engag ing prominently the schools in the Arbor Day exercises was also then inaugurated. A State forestry bureau was created in 1885, consist ing of three unpaid commissioners, charged with the duty of ascer taining the forest conditions of the State, of investigating the causes of waste, suggesting legislation, and reporting upon the same; also of establishing a forestry station on the grounds of the State University. An appropriation of $1,000 annually is set aside for these excellent purposes, a sum not sufficient to pay even a competent clerk. The in defatigable exertions of the Secretary of the commission have, never theless, placed the matter before the public in two reports. A State forestry association is also engaged in creating public interest.

INDIANA.

(4,300,606 acres woodland, or 19 per cent., of which 97.3 per cent. is in farms.)

According to the report of the department of statistics there were 4,379,759 acres of timber land in Indiana, or somewhat less than 19 per cent. of the total area of the State. This acreage was re duced to 4,000,606 acres in 1886, while the new clearings for agricul tural purposes amounted to 144,189 and 193,001 acres, respectively.

This once almost entirely and heavily wooded State is, like Ohio, largely denuded. As in Ohio, over half a million acres in farms are waste lands, fit for tree growth only. The hard-wood forests of In diana, especially its oaks, hickories, and walnuts, were unequaled in the quantity of timber and development of individual trees. But little virgin growth now exists, while some of the patches of prairie in the western counties have partially grown up to timber. The swamps in the southwestern part of the State bear a cypress growth (the most northern distribution of the bald cypress) and the dunes along Lake Michigan bear a stunted growth of white and gray pine, while Jersey pine covers the gravel hills in the southeastern

ounties. Walnut and poplar are practically gone; white oak is apidly diminishing and growing poorer in quality. The chief industries making demands upon the forests are stave-mills, general ooperage, wagon, furniture, and cabinet factories. For these there s a fair present supply, though no outlook for the future beyond a ew years.

The following table represents the status in 1886 of the manufactres relying on forest products:

Manufactures.	No. of establishments.	Capital invested.	Value of raw material.	Value of product.	No. of employés.	Wages paid.
sing wood entirely:						
Saw-mills	1,135	$3,094,980	$6,776,665	$10,598,320	6,024	$1,466,603
Planing and saw-mills combined	243	1,573,325	2,190,015	3,734,999	3,175	994,245
Stave and heading factories	85	598,750	1,640,360	2,696,200	1,758	702,550
Cooperage shops	342	507,115	860,910	1,912,640	1,940	788,355
sing wood principally:						
Wagon manufactories	289	1,223,533	1,709,784	3,654,336	2,286	869,350
Carriage manufactories and shops	238	821,455	876,700	2,121,760	1,613	716,840
Furniture and cabinet shops	286	2,919,010	3,190,236	6,913,268	5,729	2,423,865
Agricultural implements	73	1,846,950	3,318,385	5,147,135	1,719	1,112,724
Total	2,691	12,579,118	20,563,055	36,778,658	24,244	9,074,532
atio to other manufactures (per cent.)	22.6	24.2	22.4	23.2	34.8	32

An act of 1818, amended in 1831, makes the wilful and malicious ring of woods or allowing fire to spread through negligence an inictable offense. The danger from fires in the deciduous woods being mall there seems little damage likely to result from it. There exist tock laws almost universally, allowing both criminal and civil prosecution if property is damaged. No private or State interest in the natter of forests is reported. Arbor Day has been observed to some xtent since 1884, but as yet it has received no legal sanction.

ILLINOIS.

(3,500,000 acres woodland, or 9.8 per cent., of which 100 per cent is in farms.)

Illinois is known pre-eminently as the Prairie State. The northrn portion, embracing two-thirds of its area, and the portion best nown and most densely settled, consists of gently rolling prairie, the mooth treeless surface of which is broken only by occasional groves f oaks of various species and belts of trees along the river courses. With the increase of settlements and the consequent decrease of anually recurring fires, these timber belts and groves have in many ases been enlarged. Artificial planting by settlers and railroad comanies for wind-breaks, shelter belts, and groves, has also tended to ncrease the timbered area, so that there is probably more forest rowth now in central and northern Illinois than when the settlenent by the whites began. The southern part of the State, bounded y the Mississippi and Ohio Rivers, was originally covered with a ense growth of deciduous trees and some cypress. Much of this has een cut and removed for lumber and to open land for cultivation, r at least the best timber has been culled.

While the lumber production from native timber is of little acount, the lumber manufacturing interests are considerable, being upplied from the northern pineries and southern hard-wood forests.

Chicago is well known as the chief lumber-distributing point of th United States. According to the "Northwestern Lumberman," th receipts at Chicago during the year 1887 were 1,592,113,000 feet c pine and 254,074,000 feet of hard wood, to which must be adde 612,990,000 shingles, 52,239,000 laths, 3,914,550 cedar posts, 5,039,82 railroad ties, 852,640 telegraph poles, and 3,850,000 feet of timber, or round total of 190,000,000 cubic feet of wood.

Losses from fire have been comparatively small. A law enacte in 1819, amended in 1823, permits the firing of woods or prairies onl between the 15th of April and the 15th of October, and punishes neg ligent and willful firing by a fine. A law enacted in 1869 determine the liability of railroad companies for damages from fire communi cated by locomotives. Stock laws exist in some parts of the State.

The University of Illinois, in Champaign, has a very instructiv plot of experimental forest planting, which was begun in 1869, a interesting account of which is found in the thirteenth report of tha institution. No special instruction in forestry, however, is given a the university. Professor Burrill writes :

"Not many forest groves have been planted by individuals an none by corporations. Still, the number of trees for farm shelter i very great. In some localities individuals have intelligently pre served woodlands, but usually no such care has been taken; the na tive forests are gradually disappearing."

A law of 1874, offering a bounty of $10 an acre to any one plant ing forest trees and cultivating them for three years, does not seen to have operated as an inducement to much planting. Some interes in forestry has been awakened, however, in recent years. At a meet ing of the board of agriculture in 1886 the president called atten tion to the need of systematic and thorough effort to preserve por tions of the original forests of the State and of giving encourage ment to the work of tree-planting wherever needed. On his recom mendation a standing committee on forestry was appointed. I 1887 the legislature invited the forestry congress to hold its annua meeting within the borders of the State and also established Arbo Day.

WEST VIRGINIA.

(9,000,000 acres, or 57 per cent., in forest.)

The forest growth of this State is in the main composed of hard woods, to which in the southern and eastern mountain regions ar added bodies of white pine, black spruce, scattering hemlock, and occasional short-leaf pine. The white and chestnut oaks form the prevalent growth, while black walnut and cherry used to be and are still in parts quite abundant. The tulip tree, especially in the many coves of the mountains, reaches magnificent dimensions and forms no inconsiderable part of the forest growth. Other timbers, prom inent in certain localities, are the chestnuts of large diameter on the gravelly mountain tops and sycamore and beech along the water courses. Black locust finds its native home on the hill-sides, and hickories, ashes, and birches of fine size are also found.

The central and southern portions of the State are still largely un touched and heavily timbered, but along the river courses the mer chantable timber is mostly removed and the walnut is culled largely even in the interior. The development of the immense forest wealth of the less accessible portions is only now beginning with the increase

of railroad building and promises to be very rapid. Much wasteful cutting of oak for staves and of walnut for fence material has been perpetrated, and the other careless practices prevalent in all parts of the United States deteriorate either the present or the future value of these forests. There are no data at hand which could be used to show the increase of lumber business since the census year. This must have been considerable.

The annual mill capacity of the State in 1886 was about 4,000,000 feet, of which 50 per cent. was in portable saw-mills, oak, tulip, walnut, and cherry being the main staples. The principal centers of lumber manufacture are situated at Parkersburgh and Ronceverte.

The code of laws contains provisions punishing unlawful and malicious firing of woods, but, says one reporter, "timber has so little value that I never knew a case in which the law was put in force." Yet, says another reporter, "a vast amount of damage has been done by fires; sometimes a whole mountain is utterly destroyed by fire." The census places the total loss from forest fires at $155,280 in 1880, which, of course, does not include prospective damage in the deterioration of young growth and soil.

Arbor Day was introduced in 1883 by the then superintendent of public schools, B. L. Butcher, but was not legalized, and nothing of note showing interest in forest management or forest protection is reported.

KENTUCKY.

(12,800,000 acres forest, or 50 per cent., of which 78.2 per cent. is in farms; other estimates reduce this area to only 30 or 35 per cent. of total area.)

The characteristic growth of Kentucky forests all over the State is the White Oak, mostly associated with the tulip tree, and a great variety of hard woods, which change according to locality. In the southeastern mountain region of the Cumberland plateau alone pines are found, mainly *Pinus mitis* and *rigida*, also *P. strobus* and the hemlock. This forest region, containing in portions a magnificent growth, is largely untouched, the deep valleys and wild ravines making it as yet inaccessible and thus protecting the natural water reservoirs of the State. Yet logging of tulip has already begun, and the firing of the woodlands for pasturage on Black and Brush Mountains shows its effects by the absence of undergrowth. This region comprises about 4,000 square miles. In the northeastern counties the hard woods find use in supplying charcoal to several iron furnaces.

In the level and fertile Blue-grass region, occupying the central part of the State, lies the main farming country; here several tracts of former prairie make themselves noticeable by the composition of the timber growth, in which the White Oak is absent and inferior black oaks prominent. In the southwestern part of the State, which is still heavily timbered, the river bottoms and swampy portions bear a heavy growth of Cypress, Sweet and Black Gum, Beech, Ashes, Sycamore, Tulip, and the White Oak in perfection, and in the less accessible region Black Walnut, which is still cut for fence rails, etc., like the valuable White Oak; the higher portions show Chestnut Oak, various black oaks, hickories, and in some localities also chestnut. Noticeable indications of the bad effects of an unwise land policy are the many wash-outs to which the "turned out" old fields are

subject, and the deterioration in kind at least of the second growth, due to the practice of firing the woods.

The manufacture of wagons and carriages, agricultural implements and furniture, and of cooperage stock draws largely on the forest resources, but by no means to an alarming extent. The 2,319 establishments in the State relying on wood supplies had invested $17,414,246 in 1885, and were using material valued at $14,576,014, with products valued at $29,446,339. The leading places for these manufactures are Louisville, Covington, Maysville, Newport, and Paducah. The lumber product, mainly tulip and oak, of 806 sawmills in 1885 was placed at $4,889,196. Louisville is said to be the best and cheapest hard-wood lumber market in this country, if not in the world.

As early as 1831 the citizens of Harlan County were wise enough to have a law passed forbidding the firing of woods. In 1835 seven more counties followed in this wise course, and in 1840 a penalty of $100 to $300 was placed on setting fire to woods in Clay, Rockcastle, Laurel, Greenup, Pulaski, Perry, Knox, Harlan, and Carter Counties, and partially in Grayson, and the constables, with the aid of the "tithables" in their districts, were required to extinguish fires at the expense of the county. With few exceptions the former practice of setting fires has been seemingly discontinued, although some reports still complain of it.

By joint resolution of the legislature "Arbor Day" was established in 1886, but not made a legal holiday, and but little attention was paid to the proclamation appointing April 2, 1887, as Arbor Day. A most excellent beginning towards rational forestry information was made by the geological survey of the State in its reports on the timber and botany of the State, which an unwise parsimony has restricted in its scope. The reports of the commissioner of agriculture, Hon. John F. Davis, show a gratifying appreciation of the importance of this source of wealth to the State, and the formation of a forestry association now pending promises well for the future.

TENNESSEE.

(16,000,000 acres wooded, or 60.2 per cent., of which 70.2 per cent. is in farms.)

Perhaps no State in the Union has a larger proportionate area of valuable timber lands. Beginning with the bottom-lands of the Mississippi on its western border, an area of 900 miles, of rich soil and covered with a dense forest growth, the surface of the State is characterized by a succession of elevations and depressions having a general northeastern and southwestern direction, and ending in the high range of the Appalachian chain on the eastern border, portions of which have an elevation of 6,000 feet above the sea level.

The forest growth of Tennessee is much like that of Kentucky, consisting mainly of hard wood. First in value, as perhaps in extent of distribution, are the oaks, of which twelve species are found in greater or less abundance. The most valuable, the white oak, attains unusual size in the valley of the Tennessee, and in the counties bordering the Mississippi. It is found also in considerable quantities in eastern Tennessee. It is especially sought for the manufacture of staves for exportation to Europe, large quantities of which are annually shipped from the lower part of the Tennessee River.

The chestnut oak, so valuable for its bark for tanning purposes, and second only to white oak for railroad ties, is abundant on the

highlands of middle Tennessee and those bordering the Tennessee River on the west. The poplar (tulip tree) is found almost everywhere and attaining great size, especially in middle and western Tennessee. In one county a few years ago there were fifty-five mills, whose daily production of poplar timber was 1,000,000 feet. Trees 6 and 7 feet in diameter are not uncommon. Probably no State has a greater quantity of black walnut. In some places remote from roads and streams it is still used for fences. Trees 6 feet in diameter were common a few years ago. Hickories abound, one or more kinds being found in all parts of the State. White and blue ash were formerly very plentiful in all parts of the State, but are now becoming scarce, except in regions remote from lines of transportation. Bass-wood abounds in the central basin and in eastern Tennessee, and the maples are found everywhere. Sassafras is also abundant and of great size, especially in western Tennessee. Hemlock pine and spruce are found on the high slopes of the Cumberland plateau and the ridges of the Alleghanies on the eastern border. Two or three counties in the central part of the State have had an exceptionally fine growth of red cedar. Along the Mississippi and in swampy places on the lower portion of the Tennessee cypress abounds, and the sweet gum is found in wet and marshy places throughout the State.

In lumbering operations in this State, as in most hard-wood forests, the trees are seldom cut clean in a body, and lumber is not sold on the stump by the acre, but a system of culling prevails, the same ground being gone over almost every year and the largest trees taken out.

The four great lumber centers are Nashville, Memphis, Chattanooga, and Knoxville. Nashville is said to be the largest hard-wood lumber market in the country. It has 19 saw-mills (13 band and 6 circular) of an aggregate annual capacity of 140,000,000 feet B. M. The amount of lumber sawed in 1887 was 100,000,000 feet. The amount received was 30,000,000 feet, chiefly walnut, cherry, ash, poplar, elm, maple, and gum. Amount of lumber shipped 80,000,000 feet. Capital engaged in lumber business, $4,000,000. Memphis has 7 saw-mills, the daily capacity of which is 200,000 feet. The annual cut, 1887, was 60,000,000 feet; lumber received, 24,180,000 feet; lumber shipped, 14,083,000; capital engaged, $1,000,000. Chattanooga has 5 saw-mills, the annual capacity of which is 40,000,000; actual cut, 1887, 27,000,000 feet; capital engaged, $724,000. Knoxville has 6 saw-mills. The largest produces 18,000,000 feet annually, three-fourths poplar, one-fourth pine. Annual cut, 1887 (estimated), 30,000,000 feet; capital engaged, $202,000.

About 1,000,000 acres of forest were reported as burned over by forest fires in 1880, involving a pecuniary loss of more than $5,000,000. Forest fires prevail mostly in the eastern, mountainous part of the State, while in the central and western portions the fires are less frequent and less destructive. An attempt has been made to ascertain the damage by fire during the unusually dry autumn of last year. Reports have been received from 87 out of 96 counties. The principal damage, in the estimation of the people, was the destruction of fences and the consequent exposure of crops to the inroads of cattle. Great, incalculable damage was done to the forests both by fire and the browsing and trampling of cattle, causing the destruction of the undergrowth, the hope of the forests for the future. This loss the people generally do not appreciate. In many parts of the State for-

est fires are regarded as a positive advantage, promoting the growth of grass on which to pasture the cattle, and the forests are often purposely set on fire for this end. Frequently the woods are fired by chestnut gatherers, who burn the leaves in order to expose the fallen nuts to view, or by hunters, who burn them to lessen the sound of their steps when in pursuit of game.

By the law of 1857–'58 any person setting fire to any woods not his own, or to his own without giving two days' notice to persons owning adjacent lands and also taking care to extinguish such fire before it spreads beyond his own land, is liable to fine and imprisonment, and payment also for all damages.

An act of the legislature, at its last session, requires the observance of Arbor Day by all the public schools of any county on any day in November which shall be designated by the county superintendent of public schools. Mr. James Byars, of Covington, an agent of this Department, is laboring to stir up in his State interest for forest preservation.

ARKANSAS.

(28,000,000 acres woodland, or 81.2 per cent., of which 28 per cent is in farms.)

In the extent of its woodlands and in the quality of its timber Arkansas stands very high among the States. Almost all parts of the State are well timbered, with the exception of a few prairies in the northern and western portions. North of the Arkansas River the forests consists of the deciduous-leaved species of the Mississippi Basin developed to perfection, with here and there limited areas in which the Short-leaf Pine is admixed. The southwestern portion of the State is almost a continuous pine forest, the short-leaved species abounding on the higher grounds and the Loblolly pine occupying the lower and moister situations, with hard woods intermixed, which become prominent along the water-courses. "Great bodies of valuable cypress cover the extensive swamps that stretch along the eastern border of the State or line the bottoms of the White, Arkansas, Washita, and Red Rivers."

The resources of Arkansas in general are as yet but little developed and her timber supplies comparatively little drawn upon. No recent statistics of the amount of lumber product are on hand, but the sawing capacity of the mills in 1886 may be placed at 2,000,000,000 feet. During the census year forest fires were reported as devastating 858,115 acres of woodland, valued at $259,470. Most of the fires were occasioned by farmers in clearing land for agricultural use, or by careless hunters. Probably many fires occurred of which no reports were made.

The law of 1875 provides that any person who willfully sets on fire any woods, marshes, or prairies, so as to occasion damage to another, shall be liable to a fine of from $25 to $300. Any one willfully setting on fire woods, marshes, or prairies, not his own, is liable to a fine not exceeding $100 or imprisonment from two to thirty days. He is also liable to pay double damages. Any person who shall set on fire grass or other combustible material on his own premises so as to damage any other person shall make satisfaction in single damages to such person, unless he gives notice of intention to occupants of adjoining farms and uses due caution to prevent the fire from getting out to the injury of another.

"To get rid of the timber" is the only forestry interest reported from the State.

MISSOURI.

(16,000,000 acres wooded, or 36.4 per cent., of which 63.4 per cent. is in farms.)

Missouri is one of our well-wooded States. The southern and southwestern portions of it were originally covered with a "dense forest of hard woods, through which, in the southern counties, extensive areas of the Short-leaved Pine (*Pinus mitis*), covering gravelly ridges and the low Ozark hills, were common." In general terms a line drawn from the southwestern to the northeastern corner will define the western boundary of the wooded part of the State. Beyond that line on the west and north the forests are largely confined to the broad bottom-lands in belts, which become narrower and less heavily timbered, till in the extreme northwest they almost vanish. The eastern and southern portions of the State still have the appearance to the casual observer of being well wooded, and the people have not become sensible of the need of any special action in behalf of their forests. But the "best trees have been cut in the neighborhood of all settlements and for a distance varying from 5 to 20 miles back from all lines of railroad." Good white oak and black walnut, once very abundant, are now hardly to be found. In the older portion of the State since the enactment of the fence law restraining cattle from running at large there has been an improvement of the forest growth, as the young sprouts have been allowed to grow instead of being browsed and trampled down as formerly.

According to the last census there were 881 establishments in Missouri engaged in the lumber industry, having a capital of $2,867,970, employing 6,678 hands, consuming logs of the value of $3,113,049, producing 399,744,000 feet of lumber, and other articles, such as laths, shingles, etc., having a total value of $5,265,617. Of this product 334,199,000 feet of lumber, 78,728,000 laths, and 127,591,000 shingles were manufactured from logs cut in Wisconsin.

Forest fires have been destructive, 783,646 acres of woodlands having been reported as burned over in the last census year, with an estimated loss of $294,865. The origin of these fires was attributed to careless hunters, to farmers in clearing their lands, and to sparks from locomotives. The State, however, has laws* in regard to forest fires, providing a penalty of from $50 to $500 for the willful firing of any woods, marshes, or prairies, so as to occasion damage to any other person, and a fine of $500 or imprisonment for one year, for willfully setting on fire the woods, marshes, or prairies of another, but they seem to be inadequate, or there is a lack of public sentiment to enforce them.

Missouri adopted Arbor Day in 1886, the State superintendent of schools designating the particular day to be observed.

"A brief period at the State College of Agriculture is given to teaching the laws of forestry. Incidental private interest, unorganized, exists and shelter belts have been planted in the prairie region of the State."

IOWA.

(2,300,000 acres woodland, or 12.7 per cent., of which 100 per cent. is in farms.)

Iowa belongs to the prairie region, and though not so destitute of trees as her neighbors, Kansas and Nebraska, is but scantily

*Regarding laws against forest fires the secretary of state writes: "We have none: not necessary that we should."

supplied with forests and is dependent for her supply of lumber, for the most part, upon the great pine forests on the north of her. "The broad bottom-lands along the river of the eastern part of the State once bore heavy forests of broad-leaved trees. Further west the tree growth was less heavy in the narrower bottoms. All over the State, however, forests lined the streams and often spread, especially in the southwestern counties, over the uplands. Since the first settlement of the State the forest area has increased by the natural spread of trees over ground protected from fire, and by considerable plantations of cottonwood, maple, and other trees of rapid growth made by farmers to supply fuel and shelter." Natural timber covered in 1885 2,164,257 acres. The official reports gave the area of planted timber in 1885 as 120,737 acres, and the amount of property exempted from taxation in that year on account of trees planted as $5,889,294. The law exempting property from taxation for this cause has recently been repealed. The State Horticultural Society has offered premiums for tree planting and issued pamphlets of instruction on the subject, the result of which has been the extensive planting of groves and shelter belts, especially in the northern part of the State, where trees are most needed.

Iowa has been almost, if not quite, the first of our States to engage in the teaching of practical forestry, instruction in that subject being given regularly in the agricultural college a Ames. Much has been done by that institution in introducing and testing fruit and forest trees from the arid plains of eastern Europe, with the hope that they will be found adapted to the climate of our Western plains and prairies. It is too early, perhaps, to speak confidently of the success of this experiment.

Iowa was among the first States to adopt Arbor Day, and as early as 1874 offered twenty-one distinct premiums for Arbor Day tree planting. The Agricultural Society now offers annual premiums, but the planting is not confined to Arbor Day. The superintendent of public instruction has officially commended the observance of the day by the schools, and the school-law makes it obligatory upon the board of directors of each school district to cause to be set out and protected twelve or more shade trees on each school-house site where such number of trees are not already growing, and it is made the duty of county superintendents to see that this requirement is complied with.

DAKOTA.

(3,000,000 acres woodland, or 3.2 per cent., of which 2.7 per cent. is in farms.)

The natural forests of Dakota are confined to a narrow strip along the eastern border, widening towards the north, and to a somewhat heavy body of timber on the Black Hills, an isolated spur of the Rocky Mountain Range lying on the western border of the Territory. This body of timber has been greatly depleted for mining purposes. The bottoms of the principal streams contain extensive groves of hard wood. Along the whole length of the Missouri River there is a belt of hard-wood timber in the bottoms in bodies from 100 to 500 acres in extent. About three-fourths of the trees are burr oak, the remainder sycamore, cottonwood, green ash, box-elder, poplar, willow, etc.

With the exception of Nevada, Dakota has a smaller percentage of woodland than any other of the States or Territories, only 3 per

cent. of its area being classed as forest, and most of this is of a light character. Dakota is thus seen to be almost treeless, yet no portion of our territory needs trees more than this. The shelter which groves and forests, properly disposed, would give to man and beast from the cold blasts which in winter pour over this Territory from the frozen North, and the shelter which they would give to the crops from the hardly less injurious hot winds which often prevail in the growing season, would be of immeasurable value.

The necessity of their condition has stimulated the people of Dakota in an unusual degree to secure the benefit of trees by artificial means. The timber-culture act has been taken advantage of here more generally perhaps than elsewhere. It is officially stated that nearly 50,000,000 trees have been planted in Dakota under the provisions of this act, covering, it is estimated, 63,000 acres. Every acre of well-growing trees is valuable, yet 1,000,000 acres of trees would cover only 1 per cent. of the vast area of Dakota. Only a mere beginning of the needed work, therefore, as yet appears. A helpful stimulus to the prosecution of the work has been given by the Territorial laws, which offer an annual bounty of $2 for ten years to every one planting within the period of 1885–'90, and cultivating during three years, one or more acres of forest trees, the bounty to be paid no longer than the plantation is maintained and kept in growing condition. Any one-fourth of a quarter section, 5 acres of which shall be planted by sowing seed, or setting trees or cuttings, and the same kept in growing order, together with all improvements not exceeding $1,000 in value are exempted from taxation for ten years. Improvements of real property occasioned by setting out fruit or forest trees, shrubbery, or vineyards are not to be considered as increasing the value of such property for the purposes of taxation.

Persons intentionally setting on fire woods, marshes, or prairies belonging to others are liable by statute (1869) to a fine of from $50 to $100, and imprisonment from one to six months, and to pay for all damages occasioned. Negligent or careless firing of any woods, marshes, or prairies exposes to a fine of from $10 to $100 and action for damages. One may fire his own marshes or prairies during the months of March, April, and May provided he gives twenty-four hours' notice to all occupants of lands within 1 mile of the place where the fire is to be set.

Arbor Day was instituted in 1884 and is generally observed, and thousands of trees have been thus planted by school-children, arboreal societies and village authorities, as well as by individuals acting separately.

A forestry association was also formed in 1887.

NEBRASKA.

(1,500,000 acres woodland, or 3.1 per cent., of which 21.4 per cent. is in farms.)

This State, lying adjacent to Dakota, has similar forest conditions. Originally there was on its eastern border a narrow strip of the heavy timber of the Mississippi basin. "The broad bottom-lands of the Missouri and Lower Platte Rivers contained groves of large oak, walnut, ash, and box-elder of considerable extent." Westward the State may be said to have been treeless, with the exception of a few cottonwoods and willows along the larger streams. With the incoming of settlers the larger trees were speedily consumed. The

protection from prairie fires, secured by the settlement of the country, has recently allowed the natural forests to extend themselves and furnish an increased supply of the light woods which are serviceable for fuel, the price of which has consequently been reduced in many parts of the State to half what it was formerly. Sensible of the need of trees, both for a supply of fuel and for shelter belts, the settlers of Nebraska have given much attention to forest-tree planting. This was systematized and stimulated by the establishment of Arbor Day, which originated in this State and has been observed with so much interest and even enthusiasm that it has resulted in a perceptible change in the appearance of the country. The State Agricultural Society offers three premiums annually for the largest number of trees and cuttings planted on Arbor Day. Groves of quick-growing trees are found in abundance in connection with farms, and on many of them, especially in the older eastern counties, the trees have attained such a size as to afford all needed shelter and to yield a sufficient supply of fuel. It is believed that there are now nearly 1,000,000 acres of planted forest in Nebraska. For building purposes, however, timber has to be brought from without the State.

The law in regard to fires provides that any one negligently or willfully setting setting on fire woods, prairies, or other grounds shall be liable to a fine of from $5 to $100, and that any person whose property is injured by such fire shall also have the right to civil remedy therefor.

KANSAS.

[3,500,000 acres woodland, or 6.7 per cent., of which 28.3 per cent. is in farms.]

In general the forest condition of Kansas is similar to that of Nebraska. Lying farther south, however, it is somewhat more favorably situated for tree growth. On the eastern border of the State, "a prairie region, varying in width from 30 to 100 miles, is still heavily wooded with valuable timber along the streams, the forest growth occasionally extending and covering areas of upland. West of this region of mixed prairie and woodland the timber is confined to the banks of the streams."

Tree-planting has been vigorously prosecuted, and with results similar to those in Nebraska. The State board of agriculture reports 119,682 acres of planted forest in 1884. Arbor Day has been observed with much interest since 1875, the governor, by proclamation, designating the day to be observed as such. Early in the last year an act was passed by the legislature of Kansas establishing the office of commissioner of forestry and providing for two experiment stations, to be under the management of that officer, for the purpose of growing, testing, and distributing to those applying for them trees suitable to the soil and climate of Kansas. The Horticultural Society of this State is distinguished for the attention it gives to the subject of forestry, and its annual reports abound in valuable information upon this subject. Forest fires were reported in the census year to the extent of 7,080 acres, involving a loss of $14,700.

Willfully setting on fire woods, marshes, or prairies, so as to injure another, subjects one to a fine not exceeding $500 or imprisonment not more than six months, with liability also for all damages, and it is made the sworn duty of sheriffs, justices of the peace, and other officers to inform the proper authorities of any violations of the law.

MONTANA.

(25,000,000 acres, or 26.9 per cent.)

The principal forests of this Territory are in the western or mountainous part, the eastern portion, comprising two-thirds of the Territory, being almost destitute of timber. The most dense bodies of timber are situated on the western flanks of the main range and on the Cabinet, Cœur d'Aléne, and Bitter Root Mountains. These forests, which extend to eastern and northern Idaho, are the most extensive and valuable of the Rocky Mountain region. They guard the sources of many important streams and furnish timber supplies for an adjacent treeless territory of wide extent. Their careful conservation is of greatest consequence.

The forests of Montana are composed mainly of Yellow Pine (*P. ponderosa*), White Pine (*P. flexilis*, *albicaulis*, and *monticola*), Lodge-Pole Pine (*P. Murrayana*), Red or Yellow Fir (*Pseudotsuga Douglasii*), White or Balsam Fir, Cedar, and Yew.

Yellow Pine and Red Fir predominate, forming the bulk of the forests at the lower altitudes. White Spruce, Tamarack, and Balsam are found on the higher elevations.

The deciduous species most worthy of mention are the Cottonwood, Balsam (Poplar), Aspen, Box-Elder and Mountain Mahogany.

Yellow and White Pine, Red Fir, and White Spruce are the principal timber trees. The first is the largest and most useful, and furnishes most of the building lumber. In favorable situations this tree attains a height of 100 feet and a diameter of 6 or 7 feet. The White Pine is of smaller growth than the Yellow, and the wood is softer and more liable to decay. A dense slender growth of Lodge-pole Pine covers large mountain areas. It grows from 60 to 70 feet high and from a few inches to 2 or 3 feet in diameter, often forming masses so dense that passage through it has to be effected by the ax.

The smaller trees are used extensively for fencing by the Indians in the construction of their lodges and for "lagging" in mine timbering.

Cottonwood and Box-Elder border the streams at low elevations. Aspen largely replaces the original growth on surfaces which have been denuded.

The forest area of Montana, though large, is being rapidly reduced. The destruction of the forest by fires is almost beyond estimate. The territorial laws prescribe penalties for willful or careless setting of fires or failure to extinguish them, and county commissioners are required to post notices annually calling attention to the laws. In spite of these precautions fires are frequent and very destructive.

A recent act provides for a rebatement of taxes, under certain conditions, to persons planting and cultivating forest trees.

WYOMING.

(7,800,000 acres wooded, or 12.5 per cent.)

The forests of this Territory are mainly in the northwestern portion, embracing the Yellowstone Park, and in the southeast following the general course of the main range of the Rocky Mountains. The best timber is found on the southern part of the Big Horn Mountains, the central portion of the Laramie range, Medicine Bow and

Sierra Madre Mountains, and the northern spur of the Uintah range, which extend from Utah into southern Wyoming. The Shoshone, Teton, and Snake River ranges also bear heavy forests.

Considerable timber, mostly Yellow Pine, is found on the Black Hills near the line of Dakota.

Yellow and White Pine and White Spruce are the principal timber trees. Lodge-pole Pine is the prevailing forest tree in a wide area along the mountain range north and south of Laramie. It is also common in the northwestern and other portions of Wyoming. It often replaces the original growth after it has been swept away by fires. Red cedar has a scattering growth on the foot-hills and low elevations in many parts of the Territory. Cottonwood fringes many of the streams. The entire forest area of Wyoming is estimated at 12,000 square miles. Large portions of it, however, are thinly stocked, and other parts have been overrun by fire.

The principal demands upon the forests are for railway timber and ties, the manufacture of lumber for local use, and material for fuel and fencing. It is estimated that 40 per cent. of the lumber used in the Territory is imported.

The laws prescribe a penalty of fine and imprisonment and satisfaction in damages for willful or careless firing of woods, marshes, or prairies. Forest fires, nevertheless, are frequent and destructive, the census reporting 83,780 acres burnt in 1880, involving a loss of $3,255,000.

No officers are specially charged with the enforcement of the laws, and the guilty parties are rarely apprehended.

COLORADO.

(10,630,000 acres woodland, or 16 per cent.)

The timber of Colorado is nearly all in the high western mountainous portion of the State. A tongue of timbered land extends into the mid-eastern portion for 30 miles along the crest of the Arkansas-Platte divide, and another tract extends for a short distance into Las Animas County on the southeast. With these exceptions the eastern half of the State is destitute of timber. Some of the best timber is found in the southwestern portion of the State, in La Plata and Archuleta Counties. Much of it grows on high rolling plateaus. The trees are tall and straight.

Yellow and White Pine and White Spruce (*P. Engelmanni*) are the predominant species and the most useful for general purposes. The Spruce (locally known as Red Spruce) grows on higher elevations than the Pines, and is not so plentiful or so easily obtained as the latter. Its wood is superior to that of the others. Piñon, though not in large forests, has quite a wide range, and is largely used for fuel and the production of charcoal. The borders of streams and bottoms of the cañons are occupied by cottonwoods, willows, cherries, oaks, and other deciduous growth of little value. Large areas on the high mountains are covered exclusively with a dense growth of the quaking aspen, which very generally here replaces the coniferous trees where they have been destroyed by fire.

The high valleys or "parks," as they are here locally called, when timbered at all, are covered with a dense growth, in which the lodge-pole pine (*Pinus Murrayana*), also common at high elevation in the spruce forests, is the prevailing and often the only species, disputing with the aspen the possession of the burned soil. The high plateau

of southwestern Colorado is either treeless or is thinly covered with an open growth of small, stunted junipers.

The forests of the Colorado foot-hills afford abundant fuel and fencing material to supply the wants of the present population of this part of the State. Coarse lumber, suitable for the timbering of mines and for railroad construction, is manufactured from the fir and pines of the lower mountain slopes, which have also furnished immense quantities of fuel and railway ties. The timber, however, of this forest most accessible to mining centers and the lines of railroads has already been destroyed, while its productive capacity is everywhere impaired by wasteful methods of lumbering and destructive conflagrations. The elevated spruce forests, which contain the only great bodies of heavy timber found in the central Rocky Mountain region, have thus far, on account of the difficulties of operating on them, escaped all serious inroads from the ax of the lumberman. Small portable mills, however, have been established in these forests to supply the wants of some of the most elevated mining centers, and fires every year reduce their extent and value.

The consumption of lumber in the State during the last twelve months is estimated at 120,000,000 feet B. M., two-thirds native timber and one-third imported.

Forest fires are very frequent and destructive in Colorado, and are the more injurious in their results because the forests are not easily reproduced here. During the census year 113,820 acres of forest were reported destroyed by fire, with an estimated loss of $933,500. The law of 1861 subjects to a fine or imprisonment persons willfully setting fire to prairie grass or to leaves or underbrush in forests so as to destroy trees. They are subject also to fine if damage to the forests is occasioned by careless firing of grass or underbrush. By a law of 1879 railroad companies are required every year to plow a strip of land 6 feet wide upon each side of their line of road, sufficient to prevent the spread of fires.

This is the only State which recognized in its constitution the need of a forest policy (in 1876). But it was only in 1885 that the general assembly of Colorado created the office of state forest commissioner (Col. Edgar T. Ensign, Denver), and county commissioners and road overseers throughout the State were constituted forest officers. Though most of the timber lands in the State belong to the General Government, the State authorities are likely to give special attention to preventing the outbreak or spread of forest fires, and will co-operate with the Federal officers in the protection of forests.

Timber planting in the treeless sections of the State requires mostly the aid of irrigation, but has been practiced quite extensively in some parts of the State in late years.

An active forestry association was formed in 1884 and has been instrumental in bringing about the recognition of forestry interests by the State government.

NEW MEXICO.

(8,000,000 acres wooded, or 10.2 per cent., of which nearly 3 per cent. is held by farmers.)

The principal forests are confined to the mountain chains, but other parts of the Territory are more or less wooded. On the wide mesas, which form a prominent feature of the southwestern and southern portions, are found scattered growths of Cedar, Juniper,

and Piñon, while the depressions on the mesas contain fine groves of Mesquit. In the moutain valleys, gulches, and cañons are found the Yellow Pine, Piñon, Dwarf Maple, and Scrub Oak. On the higher ranges, in the northern portion of the Territory, in addition to the Pines are found the White Spruce and the Red Fir. Juniper is common on the foot-hills of this section. The river valleys are bordered with Cottonwood, Box-Elder, several varieties of Willow, Alder, Ash, Sycamores, Cherries, and Mulberries. On the southern plains or wide sandy valleys the prevailing growths are Yucca, Madrona, and Palo Verde (Acacia). On the mountain slopes the second growth is often Aspen. The elevated plain which occupies the eastern portion of the Territory has no forests and is practically treeless. The best timbered region of New Mexice is in the southwest and includes the Magdalena, Mogollon, Sierra Diablo, and other high ranges. Large bodies of Pine, Spruce, and Fir, suitable for lumber, are found here. In the northern mountains, at the headwaters of the Rio Pecos, there is some excellent timber. Yellow Pine is, on the whole, the most valuable timber tree of New Mexico and furnishes a large proportion of the native lumber.

The most inaccessible slopes of some of the highest ranges are covered with forests of cypress (*Cupressus Guadalupensis*). The coniferous forests of these mountains are dense and valuable, and, though not yet accessible for lumbering operations except at a few points, they seem destined to become an important factor in the future development of the whole region. They can, if properly protected, supply with lumber indefinitely a larger population than will probably occupy this part of the United States.

The deciduous trees of this entire southwestern region, often of considerable size, are generally hollow, especially the oaks; they are of little value for any mechanical purpose, although affording abundant and excellent fuel.

The laws provide for the punishment of persons who willfully or maliciously set fire to any woods and marshes or prairies not their own, or who shall intentionally or by neglect permit the spread of fire from their own grounds, and such persons are also liable to make satisfaction in damages for all injury thereby sustained by others. Sixty-four thousand and thirty-four acres of forest were burned in New Mexico during the last census year.

IDAHO.

(10,234,000 acres woodland, or 18.5 per cent.)

Nearly half the Territory, its southern portion, consists of treeless plains, lava beds, desert lands, or thinly timbered mountain ridges. The forests are found in the northern mountainous part of the Territory; the growth is mostly scattered and open on the many ridges, but in the Bitter Root and Coeur d'Alène Mountains it becomes dense and valuable. Excellent timber is seen in the vicinity of the Payette River and its tributaries. In the swamps of Shoshone and Nez Perces Counties cedars are found which sometimes reach a height of 300 feet and a diameter of from 6 to 9 feet.

Bull Pine is the principal timber tree, together with Douglas Fir (Red Fir), which occurs on both high and low mountains. The central portion of the Territory, occupied by the Salmon River Mountains, has been explored but little and the character of its timber is not known.

The lumber manufacture of Idaho for the year 1886 is estimated at 50,000,000 square feet, and it is supposed an equal amount was used for fencing and fuel, while 9,000,000 feet are estimated as imported from outside, mostly for railroad construction.

Fires were reported in 1880 as having destroyed 21,000 acres of woodland. Laws have been recently enacted imposing penalties for willful or careless setting of forest fires or failure to extinguish camp fires. Arbor Day was established by law in 1886.

The Territory is adapted to tree growth. Much of its surface is incapable of agricultural use, but offers a source of much wealth in the future if appropriated to timber. Some tree-planting on timber claims has been done, but requires for success in most parts irrigation. A careful working of the mountain forests is indicated as the preferable course.

NEVADA.

(2,000,000 acres wooded, or 2.8 per cent.)

Nevada, in respect to forests, is the most barren and naked of all States and Territories, having less than 3 per cent. of her area forest-clad. As a whole the State is treeless. There is a fringe of forest of limited extent on the southwestern border where that border is overlapped by the sierras of California.

Aside from this the forests are confined to the low ridges of the central and southern portions of the State. Scattered masses of stunted White Pine (*P. flexilis*) are found on more elevated parts of these ridges, and on the lower portions are Nut pines and the Mountain Mahogany (*Cercocarpus*), here attaining its best development. Below the Nut pine low, stunted Junipers cover the foot-hills, often extending, in the central part of the State, across the narrow elevated valleys which separate the low mountain ranges.

The great development of the mining interests of Nevada has already nearly exterminated its scanty and stunted forests. The White Pine has been cut in the neighborhood of mines from all the mountain ranges, and the most accessible Nut pine, Juniper, and Mountain Mahogany have been converted into cord-wood or made into charcoal. The forests of Nevada are nowhere reproducing themselves, and a scarcity of fuel, even for domestic purposes, must soon be felt.

Scanty as the forests are, wherever the land has been put under irrigation tree-planting has been attended with complete success, and the possibility of securing a large addition to the present forests of the Territory in this way has been assured.

The State has laws for the protection of forests from fires, but the penalties affixed are so light that they have little effect in preventing the careless use of fire by hunters or others camping on timbered land. Arbor day has been recently established by act of the legislature.

UTAH.

(4,000,000 acres woodland, or 7.6 per cent.)

With respect to timber Utah is much like its neighbor, Colorado, combining a treeless plain with timbered mountain ranges on one side of the Territory. The valleys or plains are destitute of forest growth, and in the early times of settlement willow brush was resorted to for fencing, adobe bricks for building, and sage brush for

fuel. The valuable timber, as much as remains, is found in the cañons and coves, the mountain sides having for the most part only a scrubby growth of comparatively little account. The Uintah Range, the eastern flank of the Wahsatch, with the San Pete and San Pitch Ranges, are generally more or less wooded with conifers. The western flank of the Wahsatch Mountains has been nearly stripped of what good timber it may have had, and from that range westward to Nevada it may be said that the country is destitute of timber and requires irrigation for its agriculture. In the southern and extreme southeastern portions of the Territory there is a thin covering of scrubby forest growth, mostly juniper and piñon.

Of the timber of Utah it may be said that the best trees furnish only lumber of an inferior quality. The forests are composed chiefly of Red Cedar, Red or Douglas Fir, Spruce, with occasional Bull Pine and White Pine (*P. flexilis*). More than half of the forest growth of the Wahsatch Range is composed of this last pine, of inferior quality. On the Oquirrh the trees are chiefly Douglas Fir.

For lumber of good quality Utah is dependent almost entirely upon supplies from the Pacific coast and the Eastern States, yet the total cut in Summit and Wahsatch Counties was estimated in 1886 at not less than 2,000,000 feet of lumber, 300,000 cubic feet of mine timber, and 12,000 cords of fencing and fuel; and this, it is claimed, is only 20 per cent. of the cut of the entire Territory.

Forty-two thousand eight hundred and sixty-five acres of timber were reported burned in the census year 1880, valued at $1,042,800.

The laws of Utah, 1876, declare it a misdemeanor to maliciously or negligently set fire to, or cause to be set on fire, any woods, prairies, grasses, or grain, on any lands, public or private, but without specially prescribing the penalties for so doing.

Recent laws of the Territory seek to encourage the growth of timber by exempting from taxation to the amount of $500 an acre for five years the property of each tax-payer who shall plant and cultivate one or more acres of forest trees. A like exemption is made to the amount of $50 for every 100 trees planted and cultivated on the borders of streets or irrigating streams.

ARIZONA.

(10,000,000 acres wooded, or 13.8 per cent.)

Arizona is a sparsely-wooded Territory. The only forests worthy of the name are to be found in the mountainous region extending from the middle of its eastern border in a northwesterly direction nearly three-fourths of the distance to the southern border of Nevada. Along these mountain ranges there are heavy forests of yellow pine and red fir, while the bottom lands and borders of the streams bear a growth of deciduous trees, of which the cottonwood, ash, cherry, alder, and walnut are the most important. There are some scattering mountain groups in the southeastern portion of the Territory, which also have a valuable forest growth. On the higher slopes the pine abounds, mingled with extensive tracts of cypress. Lower down are found the red fir and white pine (*Pinus reflexa*), with oaks and junipers. Below the elevation of 5,000 feet are scattered evergreen oaks. In the cañons and on the borders of streams in this part of the Territory are found hackberry, sycamore, cottonwood, willows, the ash, and cherry.

The yellow pine is the most valuable lumber tree in Arizona. The hard-wood trees are of inferior quality and good for little but fuel.

Until recently the heavily-timbered forests of the central and eastern portions of the Territory have been comparatively inaccessible, and have suffered little except from fires. The extension of railroads to their vicinity, however, and the consequent increase of settlements threatens destructive inroads upon them. Unhappily the people of the Territory, though so much of it is almost treeless, have not seemed to be sensible of the great value of this central forest store, and have taken no adequate measures for its preservation or its protection from fire.

A law, sufficiently stringent, against the willful or careless firing of woods or prairies, is on the statute book, but for some reason seems to lack proper enforcement.

WASHINGTON TERRITORY.

(20,000,000 acres woodland, or 44.3 per cent., of which 2.19 per cent. is in farms.)

The heavy coniferous forest growth, which has made Washington Territory famous as a lumber producer, lies on the rolling lands to the west of the Cascade Range, especially around Puget Sound and along the coast. The bulk of the timber consists of Douglas Spruce (or Red Fir as locally called), which is said to form five-sixths to seven-eighths of the entire growth. It is usually associated with the Giant Cedar and the Western Hemlock, which sometimes cover extensive tracts by themselves, and with a thick characteristic undergrowth. Along the coast the Sitka Spruce is found in considerable quantity, and on the mountain ridges firs, spruces, hemlocks, and pines of little economic value. The sand dunes along the coast and the highest peaks are treeless, while the narrow river valleys, occasional marshy localities or barrens, bear a deciduous growth of small oaks, maple, alder, and ash, cottonwood, and willows, as the case may be.

According to locality the timber in this vast forest region varies in density and quality. While the thin gravel lands produce but little useful timber, large fertile tracts are said to yield 50,000 to 100,000 feet of lumber per acre, and yields of 150,000 to 200,000 feet are said to be not unusual. Millmen, however, consider 20,000 feet a good average, and the territory of such yields is not small, making this part of the United States perhaps the most heavily wooded area in the continent. East of the Cascade Range, the great plains to the east and north of the Columbia and Snake Rivers, comprising probably one-quarter of the Territory, are destitute of timber, while the timbered area is confined to the mountain ranges to the north and west of these plains. The forest here consists of a heavy growth of Bull Pine (*Pinus ponderosa*), together with Douglas Spruce, Western Larch, White Pine (*Pinus monticola*), Giant Cedar. This growth along the eastern slope of the Cascade Range is occasionally quite dense, but in the northeastern part of the Territory and elsewhere on the ridges open and rarely of commercial value.

Recent statistics of the increasing lumber business are not at hand. In 1882 the production of the Territory reached about 600,000,000 feet, while in 1886 the saw-mill capacity seems to have been twice that amount.

The forests of Washington Territory have been subject to very destructive fires. The mountains are often invisible for weeks if

not for months together, on account of the enveloping smoke of the consuming forests. Owing to the moist atmosphere, however, which pervades the western portion of the Territory, a young growth rapidly springs up to replace the trees which are burned, and thus the forest character of the region is preserved, as it is not and can not be in the drier regions east of the mountains. The act of 1877, to protect forests and timber lands from fires, is very comprehensive in scope and stringent in its provisions. As a law, it is sufficient for its purpose. But laws, however good, do not execute themselves, and the forest fires continue to rage notwithstanding penalties of imprisonment and fines to the extent of $1,000. Some timber planting has been done in the treeless portions of the Territory.

OREGON.

(20,000,000 acres woodland or 33 per cent., of which 7.12 per cent. is in farms.)

Oregon resembles Washington Territory in its forest characteristics. The same heavy belt of coniferous timber covers the western mountain ranges, while along the valleys of the Willamette, Umpqua, and Rogue Rivers is to be found a scattered growth of oaks (*Quercus Garryana*); and cottonwoods and alders of great size, willows, maples, and ashes line the bottom-lands, furnishing supplies of various wooden-ware, cooperage, and furniture manufactures. The principal timber tree of the mountain forest, as in Washington Territory, is the Douglas Spruce. Lawson's Cypress (Port Orford cedar) has also for over thirty years formed an important factor in the lumber supply of the Pacific coast, and abounds especially in the southwestern portion of the State. But fires have destroyed even more than the ax. The easy, natural reproduction of the tree on the burned areas lends special importance to it for future forestry. Other principal timbers are the Canoe Cedar, the Western Hemlock, and the Sitka Spruce.

East of the Cascade Range the forests are comparatively light and of little value, and are confined to the northeastern mountain slopes. The southeastern portion of the State, comprising nearly one-fourth of its area, may be said to be destitute of timber.

No recent satisfactory statistics of the growing lumber business are at hand. The sawing capacity of the mills in 1886 amounted to about 500,000,000 feet B. M. Already the lumber traffic between Oregon and the southern markets of San Francisco, Mexico, and South America has reached large proportions, and shipments are made even to China and Australia. The rapidly diminishing supply of pine in the district embracing Michigan, Wisconsin, and Minnesota, together with the increased railroad facilities, have recently led to the sale of Oregon lumber in the Eastern markets. This inland trade began in 1885, and shipments were made last year at the rate of 5,000,000 feet a month, the lumber going as far as Denver, Omaha, and Chicago, most of it in the form of timber. Much of it was used for railroad and bridge construction.

Forest fires have been even more prevalent and destructive in Oregon than in the neighboring Territory, 132,320 acres having been reported as burned in 1880. The forests, however, reproduce themselves here as they do there and for the same reason, and with a little care this Pacific coast region might be preserved as a source of wealth more continuous and valuable than the mines, which are so

highly estimated, while the worth of the forests is so generally overlooked and they are given over to destruction.

The law of 1855 provides that any person willfully and maliciously setting fire to any woods, prairie, or other ground not his own, or who shall intentionally or by neglect suffer fire to pass his own grounds to the injury of any other person, shall be liable to a fine of not less than $10 nor exceeding $500.

CALIFORNIA.

(20,000,000 acres wooded, or 20.0 per cent., of which 8.3 per cent. is held by farmers.)

The forests of California are chiefly confined to the mountain ranges which form its borders on the east and west, and which unite to form its northern boundary. The northeastern and nearly all the southern and southeastern portions of the State are almost destitute of forests. Oaks, pines, and junipers are sparsely scattered over the southwestern portion, and cottonwoods and willows are found on the banks of streams. The most important forests of California, in a material point of view, are those constituting what is known as the redwood belt. This belt, extending along the Coast Range from the Bay of Monterey nearly to the border of Oregon, though occupying but a small portion of the State, territorially considered, probably contains more than half of the valuable and merchantable timber of the State. Nowhere in this country, nowhere perhaps in the world, is there to be found upon an equal area so great an amount of available and useful timber as in the redwood belt. The yield of lumber on this belt is from 5,000 to 125,000 feet per acre. The estimated amount of timber now standing is 30,500,000,000 feet and (with a trade hardly yet developed) the annual cut 215,000,000. But the difficulties attending the conversion of the redwood into lumber (the trees sometimes reaching a diameter of nearly 20 feet) are so great, and the methods of operation so wasteful, that it is estimated that not more than 1 foot of lumber is secured from 4 feet of standing wood; in other words, that not more than 25 per cent. of the redwood forests are made available for practical use.

Next to the redwood in value and abundance is the Douglas spruce, or red fir, the most widely distributed and valuable timber tree of the Pacific region. It is adapted to a great variety of uses, and flourishes in almost any soil and exposure. It is found more or less abundantly throughout the Coast Range, varying in character and quality according to its situation. It reaches its best development in company with or under shelter of the redwoods, often attaining a height of 250 feet. The estimated amount of spruce lumber manufactured in California in 1885 was 25,000,000 feet, of which two-thirds was taken to the San Francisco market. The chief supply of spruce for this market, however, was drawn from Oregon and Washington Territory, where this wood is specially abundant, 175,000,000 feet having been shipped to that port in 1885.

The most valuable hard wood of California is the tanbark oak. This tree has been wastefully used, the bark only being secured and the wood left to decay upon the ground. It is estimated that there are now remaining in the five counties comprising the redwood belt trees of this species sufficient only to yield 750,000 cords of bark.

The treatment of the forests in California has generally been very wasteful. Mining operations have been very destructive of the tim-

ber. It is generally conceded that in Mendocino County, for instance, the timber left is completely swept over by fire about once in every five years. Fires have ravaged the forest almost unchecked. Flocks and herds, turned loose upon the mountain sides for pasturage, have eaten and trampled down the young trees, destroyed the grasses, and so broken up the soil that it is washed down the declivities by the rains, and the mountain slopes, which might have been kept in a beneficent forest condition perpetually by proper protection, are denuded alike of grass and trees and made the sources of disastrous torrents. The destruction of the forests upon the hillsides has very much impaired the resources for irrigation, upon which southern California is so dependent for her agricultural prosperity.

What has been said of the waste of material in utilizing the redwood forests may be said in regard to the forests in all parts of the State where forests of any extent are to be found. As a general fact only the young and most accessible trees have been cut, and often only the most easily worked parts of these have been used, the remaining portions and large masses of trees being left to decay on the ground or to be destroyed by fire. Within a few years, however, the people of California have become so far sensible of the dangers threatening them from the destruction of their forests that they have begun to take measures for their protection. A good law against firing of woods, passed in 1872, needs only practical application.

A State board of forestry was established by law in 1885, and the three commissioners appointed have entered upon a wide range of duties of a practical nature with an energy and zeal which encourage the expectation of beneficial results (first report issued in 1886, Sands W. Forman, secretary, San Francisco).

Three forest experiment stations have recently been established under the board in different parts of the State. Experiments have been made to some extent by the agricultural station to test the practicability of introducing some valuable trees not indigenous to California. Attention has been given to the rapid-growing Eucalyptus of Australia, and such success has attended the planting of this tree thus far that it promises to be an important addition to the tree growth of the State. Groves of Eucalyptus and of Acacias are found here and there in the treeless regions.

A bill for the establishment of Arbor Day was before the last legislature but failed of adoption.

CONCLUSION.

It will have become apparent from the foregoing statements that the field of activity and usefulness of the Division is capable of extension in a great variety of directions, in proportion to the amounts appropriated and the facilities provided for its work. But such extension can hardly be expected under present conditions. The budget of the Prussian forest administration for the year 1888–'89 shows, for forest scientific purposes alone, an appropriation of $46,934 (area 134,400 square miles), while it is expected that this great and growing but undeveloped interest, extending over the vast and varied regions of the United States (3,062,990 square miles), will be subserved by an expenditure of $10,000, out of which to pay for experiments, investigations, and report upon forestry, and "the collection and distribution of valuable economic forest-tree seeds and plants."

While it may not be necessary to devote proportionately as much to the scientific development of forestry in a country in which practical forestry is almost unknown as in older countries, it must appear even to the uninitiated that under present conditions the struggle to do justice to the technical and missionary demands upon the Division must be unequal; that but slow progress can be made in any one of the proposed directions for the accomplishment of the objects for which the division is established, and that the greatest difficulty is to find the proper limitations rather than the possible extensions of its work.

Yet the time seems to have arrived when it is desirable to take up at least some of the work outlined in this report more vigorously and more thoroughly; to leave the missionary work to the forestry and other associations, newspapers, etc.; to establish the Division as a center for original scientific experiment and investigation in forestry matters, upon which to develop a reliable basis for forest management in the United States.

Respectfully submitted.

B. E. Fernow,
Chief of Forestry Division.

Hon. Norman J. Colman

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